MONTHLY WEATHER REVIEW

Editor, W. J. HUMPHREYS

VOL. 63, No. 7
W.B. No. 1161

JULY 1935

CLOSED SEPTEMBER 3, 1935
ISSUED OCTOBER 14, 1935

ANALYSIS OF A WARM-FRONT-TYPE OCCLUSION

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[Weather Bureau, Washington, July 1935]

The weather situation over the Midwest on October 26, 1933, was first brought to the writer's attention by an interesting article by Christensen.[1]

An inspection of the surface and upper-air data proved the situation to be so interesting and the contrasts in the air masses so striking that a closer study was made.

The material here presented includes the analyzed surface-maps and vertical cross-sections for the mornings of October 25, 26, and 27, 1933. The data on the surface maps are arranged in the following manner: The state of weather is entered in the usual way, and the wind direction and velocity are represented by an arrow *flying with the wind*, the number of half-barbs corresponding to the velocity in the Beaufort scale. To the right of the station is entered the temperature in degrees Fahrenheit, and underneath this the 24-hour precipitation in hundredths of an inch. Several stations which report dewpoint temperatures have these entered to the right of the temperatures. To the left of the station is entered 3-hourly pressure character, and pressure change in hundredths of an inch. Also, when occasion warrants, above the pressure change are indicated special phenomena, such as thunderstorms that occurred within the previous 24 hours. Above the station are entered the cloud amount, kind, and direction of motion; cirrus-type clouds are omitted in order to save space. Cold fronts are represented by heavy, solid lines; warm fronts, heavy dotted lines; occluded fronts by alternate heavy dashes and dots; and upper-air cold fronts by heavy dashed lines. Falling precipitation is indicated by cross-hatching.

The vertical cross sections are placed so that they face the surface maps to which they correspond. Two sections are shown for each of the three mornings; one, a west-east section including Omaha, Nebr., Cleveland, Ohio, and Boston, Mass.; the other, a north-south section, including Pembina, N. Dak., Omaha, Nebr., and Dallas, Tex. While the number of airplane stations for this study is much smaller than is available now, the situation is so clear-cut that it is possible to make a fairly satisfactory analysis for each of the 3 days. An airplane sounding in the sections is marked by a vertical line, above which the time of the sounding in E. S. T. is indicated. Each significant level in the sounding is indicated by a short horizontal line, around which the following data are placed: to the left is the temperature in degrees centigrade, and underneath this the relative humidity in percent; to the right is potential temperature in degrees absolute centigrade, and below this the specific humidity, in grams of water vapor per kilogram of moist air. At each kilometer is indicated the temperature change since the preceding day. At various levels the wind directions and velocities are represented by barbed arrows flying with the wind; the number of half-barbs corresponds to the velocity in the Beaufort scale. On the west-east sections a horizontal arrow with barbs to the left represents a west wind, while a vertical arrow with barbs at the top stands for a northerly wind. However, on the north-south sections, a horizontal arrow with barbs to the left represents a north wind, while a west wind is shown by a vertical arrow with barbs at the bottom. Clouds, haze, ice, etc., are entered at their respective elevations; if the elevations are unknown, then these phenomena are entered above the top of the sounding. Cold fronts are shown as heavy solid lines, warm fronts as heavy dotted, and subsidence inversions as heavy dashed lines. Isotherms are drawn for each 5°, and isopleths of specific humidity (grams of water vapor per kilogram of moist air, indicated by q) for each gram. All elevations referred to in the text are given in meters above sea level.

On the morning of October 25 most of the continent at the surface was covered by polar air masses. (Fig. 1.) Over the plateau region, an N_{PP} air mass [2] was advancing, displacing before it a narrow sector of N_{TP} air. The N_{PP} air had been considerably modified by a lengthy passage over the southern part of the North Pacific Ocean and was only slightly cooler at the surface than the N_{TP} air. The front separating the two air masses was clearly marked by a discontinuity in the 3-hour pressure characteristics. The surface temperatures in the N_{TP} air were low, partly because of radiational cooling of the ground on the plateau and partly because the valleys still contained remnants of an old N_{PP} air mass. To the east of the N_{TP} sector were two polar continental air masses, covering the remainder of the continent. The first of these was an N_{PC} mass, which had moved very slowly southward from the North Central States on the 22d, reaching the Gulf States and the Gulf of Mexico on the 25th. This air was considerably modified, its heat and moisture contents being much higher than the fresher P_c air mass which was moving swiftly southward behind a deep LOW that was centered off the Maine coast. The warm sector of this

[1] A. H. Christensen, Analysis of a Warm "Cold Front." MONTHLY WEATHER REVIEW, volume 63, January 1935, page 9.

[2] For a description of American air masses see H. C. Willett, "American Air Mass Properties." Papers in physical Oceanography and Meteorology, M. I. T. and Woods Hole Ocean. Inst., Volume II, No. 2.

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LOW was a broad current of tropical maritime air which extended northward past Nova Scotia. In the Canadian northwest, on the front separating the Pacific from the continental air masses, a wave which had gone into occlusion is shown as a LOW with center over Medicine Hat, Alberta. The occluded front accompanying this LOW is well marked by a discontinuity in wind direction and pressure characteristic.

The west-east section (fig. 2) for this morning shows in an exceptionally well marked manner the contrasts in temperature and moisture between the surface P_c air mass and the tropical air masses above. At Omaha, a surface temperature of $-2°$ and a q (specific humidity) of 2.6 grams is accompanied by a light SSE. wind. The temperature remains the same up to 1,200 meters while q drops to 1.8 grams. Then at 1,600 meters a 3° inversion is accompanied by a shift in wind direction to light WSW. and a q of 1.5 grams. This elevation is taken as the height of a surface of subsidence present in the P_c mass, which is also found at Cleveland and Boston on the same section. Above this inversion, an isothermal layer of 150-meter depth precedes an increase in temperature and q from 1° and 1.8 grams, respectively, at 1,900 meters to 7° and 4.4 grams, respectively, at 2,500 meters, accompanied by a shift of wind to NW., force 8. Then q drops to 3.2 grams but recovers slightly to 4.3 grams, and remains moderately high above to the top of the sounding. The intermediate dry layer may be a remnant of T_s (tropical superior) air,[3] which is so often found over the Southern States at intermediate and high levels, and which on these particular sections is present aloft over Cleveland and at intermediate levels over Dallas. However, the air above the P_c wedge seems to be mostly N_{TP}, as shown by the high temperature and moderate moisture content, and is being transported by strong NNW. winds. The presence of tropical air aloft accompanied by northwesterly winds is by no means unusual. Bjerknes [4] has shown that a tropical current flowing over a polar wedge acquires considerable curvature of its horizontal stream lines, due to the deflecting influence of the earth's rotation on a current of air which undergoes vertical divergence and convergence. In Bjerknes' example a tropical air mass lifted from the surface to 1,500 meters, during its ascent over a polar wedge, showed a turning of the stream lines from SW. at the surface to NW. and even to NNW. The author, in daily analyses of vertical sections during several months, has observed time and again tropical currents appearing aloft with NW. winds. Even over the eastern part of the country, the warm, moist T_G air is sometimes observed appearing over a P_c wedge as an NW. current.[5]

The Cleveland sounding for this morning is for the most part in P_c air. A layer of steep lapse-rate extends up to 2,000 meters, accompanied by a 10 St. Cu. cloud deck from 1,000 to 2,000 meters in which icing conditions are reported. Before the take-off, light rain and snow were observed, and evidently the P_c air, during its passage over Lake Erie, had acquired heat and moisture in its lower layers. Above the cloud deck a small isothermal layer is accompanied by a drop in q from 2.1 to 1.5 grams. This is taken as a continuation of the same surface of subsidence found at Omaha. Above this is a moderately stable layer of about 1,000 meters depth in which q drops to 0.6 grams. In the next 900 meters, the temperature increases 5° and q remains constant. At 4,000 to 4,600 meters occurs a 3° inversion and an increase in q to 1.0 grams. Above this inversion, at 5,200 meters q is 0.7 gram, which is higher than the value of 0.6 gram found 2 kilometers lower in the P_c air, but considerably lower than the value of 2.5 grams found at the same elevation in the N_{TP} over Omaha. This dry air is evidently the T_s air, a remnant of which was found at intermediate levels at Omaha.

At Boston the sounding remains entirely within the P_c current. A 400-meter thick St. Cu. deck is found at 1,000 meters, above an adiabatic layer; and above this the lapse rate is very stable. Between 1,800 and 2,400 meters, q drops from 3.0 grams to 1.9 grams, and this layer is taken as a continuation of the surface of subsidence found at Omaha and Cleveland. Above this the P_c air shows moderate stratification in temperature and moisture, which according to Willett is a characteristic of most deep P_c air masses.

On the north-south section (fig. 3), the sounding at Pembina shows the transition from P_c to N_{TP} air in the same well-marked manner as at Omaha. At 1,600 meters there is evidence of the same surface of subsidence, where a 3° inversion and a minimum of specific humidity occur. Above this level the temperature remains practically constant to 2,200 meters; between this elevation and 2,800 meters a 6° inversion and an increase in q from 3.5 to 4.3 grams are found, evidently corresponding to the transition from P_c air to N_{TP} air. However, the transitional zone between the two types of air really extends from 1,600 meters to 2,800 meters, since it is within this layer that q increases markedly. Above 2,800 meters we find temperatures and specific humidities characteristic of N_{TP} air. There seems to be no evidence of the intermediate layer of T_s air that is found at Omaha.

The sounding at Dallas on the same section shows a well-marked stratification, corresponding to three air masses. The first mass is a 1,700-meter surface layer of the older N_{PC} air which had moved slowly south several days before and had acquired considerable warmth and moisture, so much so that on the section this air mass is labelled "becoming T_G." Between 1,700 and 2,000 meters exists a transitional zone between the N_{PC} and T_s air, which is marked by a 2° inversion, a decrease in q from 7.9 to 4.0 grams, and a shift in wind from ENE., force 3, to NNE., force 2. At 2,500 meters a minimum of q is reached, 2.8 grams; above this level q increases to 3.7 grams at 3,600 meters, showing the existence of the overlying N_{TP} current, such as was found over Omaha. It is interesting to see that at Omaha the transitional zone between T_s and N_{TP} is bounded by potential temperatures of 308° and 310°, and at Dallas by 309° and 311°.

The surface map for the morning of October 26 (fig. 4) shows that the N_{TP} sector has gone into occlusion, the occluded front showing as a well-marked wind-shift line extending from Minnesota to southern Oklahoma. To the west of this front the 3-hour pressure characteristics are positive, and temperatures have dropped since the previous morning. For example, at Yellowstone Park and Cheyenne, Wyo., two high stations, which were in N_{TP} air on the morning of the 25th, the temperatures have decreased from 44° to 34°, and 48° to 38°, respectively, and the pressure characteristics have changed from negative to positive. The advance of the N_{TP} front eastward and southward was accompanied by thunderstorms at Dodge City, Kans., Sante Fe, and Roswell, N. Mex., although only light precipitation occurred.

[3] For a description of T_s air, see H. C. Willett, "The T_s Air Mass Designation as used at M. I. T.", Bulletin of American Meteorological Society, vol. 16, no. 5, May 1935.
[4] Bjerknes, "Explorations de quelques Perturbations Atmosphériques a l'aide de sondages rapprochés dans le temps." Geofysiske Publikasjoner, vol. IX, No. 9, 1932.
[5] For further discussion of this phenomenon, see H. R. Byers, "Change in an air mass during lifting" (not yet published).

The eastern limit of the N_{PP} air is found above the P_c wedge about 150 miles to the east of the surface wind-shift line. It is characterized by precipitation, and a discontinuity in pressure characteristic. While Davenport, Iowa, has rain and a steady 3-hour pressure fall of 0.10 inch, at St. Joseph, Mo., the rain, which amounted to 0.28 inch during the night, has ceased and the pressure is falling unsteadily, amount 0.02 inch, although the southerly wind shows that the station has not been passed by the occluded front (surface wind-shift line). At Kansas City it is still raining, with a southerly wind, and the pressure characteristic is an unsteady rise of 0.02 inch; at Columbia, Mo., it has not begun to rain, the wind is SE., and the pressure characteristic is a steady fall of 0.08 inch. Oklahoma City reports a thunderstorm during the night, although its wind is still SE. This upper air cold front and the surface cold front are joined in a smooth curve since of course they both mark the boundary of the N_{PP} air.

The P_c front in the northwest has moved southeastward, from Havre, Mont. on the 25th to Huron, S. Dak., on the 26th, and the occluded front is still present as a pressure trough from Sioux Lookout, Ont. to Qu'Appelle, Saskatchewan. The eastern P_c mass has now moved eastward to Bermuda and southward to the Gulf, bringing with it colder, drier air. For example, the temperature and dewpoint at Macon, Ga., dropped from 56° and 47°, respectively, on the morning of the 25th to 46° and 31°, respectively, on the morning of the 26th. The air mass, however, has not reached Brownsville, Tex., where temperature and dewpoint for both mornings are 72° and 67°, respectively, values which are characteristic for maritime tropical air in that region during the fall.

The west-east section for the morning of October 26 (fig. 5) maintains the same pattern as on the previous day, except that the P_c wedge has become much more shallow and the N_{PP} air has entirely displaced the N_{TP} air over Omaha. The P_c air over this station extends only up to 1,700 meters and is so much modified that it is called N_{PC}; at 1,700 meters the temperature and specific humidity are higher than at the surface, although the wind at this elevation is NW., force 4, while at the surface it is light southerly. The temperatures and moisture contents have risen markedly since the previous morning from the surface to 2,000 meters, while above 3,000 meters the temperatures have fallen considerably, although the moisture contents are about the same. The increased warmth and moisture in the N_{PC} air are due primarily to mixing with the warmer, moister Pacific air masses aloft and to falling precipitation, and only secondarily to its southern trajectory as shown by comparing the Omaha and Dallas soundings (fig. 6). While the latter sounding shows a steady decrease of q with elevation in the N_{PC} air, which would correspond to an upward transport of moisture from the ground, the latter sounding shows an increase of q with height, indicating that here the transport of moisture is downward from the moist Pacific air masses aloft. The marked cooling aloft since the previous day is due to the colder N_{PP} having displaced the N_{PP} air which was present above 2,500 meters on the previous day. Hence the N_{PP} is acting as a warm front relative to colder N_{PC} air and as a cold front relative to the warmer N_{TP} air. The fact that the moisture contents are high in the N_{PP} air probably shows that aloft Omaha is still on the frontal zone between the N_{PP} and N_{TP} air, as is already indicated on the surface map where the easternmost portion of the N_{PP} is found only about 150 miles east of Omaha.

The Cleveland sounding for the same section shows P_c air present up to 2,700 meters. On account of the eastward movement of the center of the HIGH from Lake Superior on the 25th to Chesapeake Bay on the 26th, the winds in the P_c air at Cleveland turned from northerly to southerly. This shift was accompanied by a considerable decrease in moisture content and temperature at lower levels within the P_c air, thus showing how the P_c air during its passage over Lake Erie on the 25th had acquired considerable heat and moisture in its lower levels, and how the return P_c air on the 26th had evidently never passed over the Lakes.

From 1,300 to 1,900 meters the temperature increases 5° while q reaches its minimum value of 1.2 grams. This evidently corresponds to the same surface of subsidence observed on the previous day. Above this level the temperature increases 2°, and q increases from 1.2 to 2.8 grams. Then a slight decrease in q is followed by a sharp increase from 2.7 to 3.3 grams in 600 meters. This intermediate dry layer, from 2,700 to 3,100 meters, is taken as the remnant of the T_s layer which was present in the section the day before; the upper layer is evidently the N_{TP} air which was present at Omaha on the preceding day. At Boston the sounding shows a similar stratification. From 800 to 1,400 meters, an inversion of 5° occurs, probably a turbulence inversion due to the strong NW. winds. Above this level exists a very stable layer, in which temperature decreases only 3° in 1,600 meters, and q from 2.0 to 1.6 grams. The surface of subsidence is taken within this layer, at a wind shift from NNW., force 8, to NW., force 8. From 3,000 to 3,400 meters the temperature increases 3°, and q increases from 1.6 to 2.2 grams. Then q decreases to 1.8 grams, and recovers slightly to 1.9 at 4,400 meters, where a small inversion of 0.5° occurs. The intermediate layer from 3,400 to 4,200 meters is taken as the T_s layer, and the layer above as the N_{TP} air, although the high moisture contents found in the N_{TP} air above Cleveland are absent, probably owing to the fact that at high levels the Boston sounding is in a transitional zone between the N_{TP} coming in from the west and the T_s which it is displacing. However, the top levels of the two soundings are very similar, Cleveland having a temperature and q of −12° and 1.9 grams, respectively, at 5,400 meters, and Boston, −13° and 1.3 grams, respectively, at 5,500 meters. It is interesting again to see that the transitional layer between the T_s and N_{TP} air is bounded at Cleveland by potential temperatures of 308° and 310°, and at Boston by 306.5° and 310°. This is in close agreement with the bounding values of the same transitional zone observed at Omaha and Dallas on the previous day.

The north-south section for the 26th shows considerable change since the previous day. A late ascent at Pembina gives us the first sounding through the P_c air which moved in from the northwest, and shows it to be a deep, cold, dry current. The temperatures and moisture contents have dropped at every level since the previous morning, the maximum temperature fall being 24° at 3,000 meters. This P_c current is relatively free from stratification, the only marked example of which occurs at 3,500 meters, where a 3° inversion and a sharp drop of relative humidity exist above an 8 A. Cu. cloud deck. This P_c air has not reached Omaha on the morning of the 26th, as is clearly shown by both surface and upper air data. The lower levels of the P_c air mass over Pembina are characterized by a steep lapse rate, and snow-squalls were reported at the surface at 7 p. m.

The Dallas sounding shows even more stratification than on the previous morning, due to the additional presence of a shallow P_c wedge at the surface which extends to about 800 meters, and which had moved in since the preceding morning. In this layer the temperatures have dropped slightly since the day before but the moisture contents have decreased considerably. Although the winds in this layer are from the SE. and SSE., there can be no doubt about the land trajectory of this air. Between 700 and 830 meters there is an increase in temperature from 11° to 16° and in q from 3.9 to 7.9 grams. Then at 1,100 meters, maxima of temperature and q are reached, 17° and 10.2 grams, respectively. This transitional zone of about 400 meters is accompanied by a shift in wind from SSE., force 7, to SW., force 5. Above 1,100 meters the temperature and moisture contents remain high to about 3,000 meters, and the winds are mostly WSW. This layer evidently is the greatly modified N_{PC} air which has almost tropical maritime properties. Between 3,000 and 3,500 meters, there exists a very stable layer in which the temperature decreases only 2°, and q decreases from 7.0 to 3.9 grams, accompanying a shift in wind to WNW. and probably to a still more northerly direction above. Then a fairly steep lapse-rate is found up to 4,500 meters where a minimum of q is found, 1.3 grams. Above this elevation q increases to 2.2 grams, decreases to 1.6 grams, and finally increases to 2.2 grams at 5,500 meters. The dry layer is evidently the T_s layer which was found at Dallas on the previous day, although the moisture contents are now lower. The increase in q at the top of this layer marks a rather broad transitional zone between the T_s and N_{TP} air, so that the stratification pattern above 800 meters is the same as on the previous day.

Looking back now over the surface and upper air maps for the 25th and 26th, certain clearcut features stand out, some of which are not in accord with Christensen's statements. First of all, there can be no doubt as to the fact that above the P_c wedge on the 25th along the Omaha-Cleveland-Boston section there exist only tropical air masses, the moist N_{TP} and the dry T_s. The N_{PP} air, which had not yet begun to ascend the P_c wedge, is present over the plateau, and its temperatures at the morning and evening observations are considerably higher than those of the P_c air, although clear skies prevailed over most of the region covered by the P_c air. Even on the morning of the 26th, when the N_{PP} air had begun to ascend the P_c wedge, nowhere in the N_{PP} air do we find as low temperatures as observed in the return P_c air. For example, on this morning, Yellowstone Park reports one of the lowest temperatures found in the N_{PP} air, 34° with a partly cloudy sky; yet Fort Wayne, Ind., in the return P_c air, has a temperature of 32°, also with a partly cloudy sky. This contrast is even more marked on the previous evening, where for example, Yellowstone Park, in the N_{PP} air at 8 p. m., has a temperature of 50° with a clear sky, while Des Moines in the return P_c air, has a temperature of 42° also with clear skies. Hence, it is seen that the lower temperatures found in the P_c air are not caused by clouds and precipitation as Christensen suggests, but result from actual temperature differences characteristic of the two air masses. This is also borne out by the isotherms in the west-east section for the 26th. For example the zero isotherm is found at about 3,400 meters in the N_{PP} air over Omaha and at about 1,600 meters over Cleveland which is in the return P_c air, and at about 1,300 meters over Boston which is still within the fresh P_c air.

In addition to the N_{PP} air being much warmer than the P_c air, it is also clearly seen that it is much more moist. For example, on the west-east section for the 26th, at 2,000 meters, we see that the N_{PP} air over Omaha has a q of about 4.1 grams, the return P_c air over Cleveland about 1.4 grams, and the fresh P_c air over Boston about 1.8 grams. Even in the return flow of P_c air over Omaha on the 25th, the moisture contents are very low, a minimum of 1.5 grams at 1,600 meters. Hence, there can be no doubt that the N_{PP} air is much more moist than the P_c air, instead of the reverse as Christensen states in trying to explain the clearing up in advance of the surface wind-shift line. As mentioned above, the high moisture contents observed in the return P_c air on the 26th at Omaha are not characteristic of return P_c air which in general acquires most of its moisture from the surface during the course of its trajectory to the south; hence the high moisture content must be explained mostly by falling precipitation from above. This brings up the question of the origin of the precipitation a hundred miles or so east of the wind-shift line, and the explanation of the clearing which occurred some 50 miles in advance of the surface wind-shift line.

From the maps for the 25th and 26th we see that it was not until the N_{PP} air began to ascend the P_c wedge that precipitation occurred. On the 25th, when the N_{TP} and T_s air masses were overrunning the P_c wedge, clear skies mostly prevailed east of the wind shift line at both the morning and evening observations. At 8 p. m. the N_{PP} mass had begun to overrun the P_c wedge only north of Huron. By 8 a. m. the next day, after the N_{PP} air had ascended the P_c wedge along most of the front, precipitation had broken out and was evidently of the shower type, 0.28 inch occurring during the night at St. Joseph and only 0.01 inch at Kansas City.

The lack of precipitation in the Midwest on the 25th despite the overrunning of the underlying P_c air by the fairly moist N_{TP}, was due to the combined effects of several factors; namely, the presence of the intermediate dry layer of T_s air which probably mixed with the moist N_{TP} air and thus caused lower relative humidities to prevail within the latter; the fact that the N_{TP} air was lifted only slightly in overriding the P_c wedge, whose average height between Omaha and Cleveland was only slightly greater than that of the average height of the plateau from which the N_{TP} air was coming; and lastly, the winds within the N_{TP} current were mostly from the NW. at Omaha and from the N. at Dallas which would ordinarily tend to cause the N_{TP} air to subside, since P_c wedges usually decrease in height southward. Actually, if we look at the north-south section for the 25th, the N_{TP} air, because of the presence of the T_s layer below it, seems to move southward with very little vertical displacement.

The precipitation which broke out over the Midwest on the night of the 25th–26th is, as we have seen, associated with the overrunning N_{PP} air. This does not mean that the precipitation is falling out of the N_{PP} air, because as in the case of the N_{TP} air only a slight amount of vertical displacement upward would result as the air moved over the P_c wedge, which was becoming more and more shallow. Furthermore the precipitation is evidently of the shower type and so would not ordinarily result from a pure warm front action. Hence, the remaining alternative is that the showery precipitation is due to cold front action between the cold N_{PP} air and the warm N_{TP} air above the stagnant P_c wedge. Looking for a precedent in cold front action between the N_{PP} air and the N_{TP} air on the surface, we see that between 8 a. m. on the 25th and 8

a. m. on the 26th, Santa Fe, Dodge City, and Roswell report thunderstorms as the N_{PP} air displaced the N_{TP} air at the surface, although very little precipitation occurred. The increase in cold front activity as both Pacific air masses overrode the P_c wedge is probably due to the increased instability of the two masses that resulted from the slight lifting they had undergone in ascending the P_c wedge from west to east. Hence, the clearing up which occurred in advance of the surface windshift was probably the usual clearing up that occurs after a cold front passage at the surface—the only difference being that this particular cold front passage occurred at some 2,000 meters above the ground.

Continuing with the analysis of the situation, we see from the surface map on the 27th (fig. 7) that the N_{PP} front over the southwest has advanced southeastward so that it has passed into the Gulf. It was accompanied by widespread thunderstorm activity on the night of the 26th–27th in Texas and Arkansas with the precipitation amounts ranging from light to moderate. The drops in temperature and dew-point since the previous morning at Corpus Christi and Brownsville, Tex., show quite distinctly that the N_{PP} air has displaced the warm, moist N_{PC} air, which is now called T_G. The fresh P_c air from the northwest has moved southward past Cairo, Ill., and eastward past Grand Rapids, Mich., while the eastern P_c air mass has moved eastward and southward and has been split by a tropical disturbance whose center, 29.32 inches, is located about 300 miles SSE. of Cape Hatteras. This air mass is now called N_{PC}, and at Hatteras it is evidently so much modified that it is called T_A.

The position of the upper air N_{PP} front on the evening of the 26th had been characterized by a wind shift from S. and SE. to SW. and also by a discontinuity in pressure characteristic. Showers accompanied the passage of this front, and thunderstorms occurred at Springfield, Mo., and Little Rock, Ark., during the day. The pressure tendencies in Illinois, Missouri, Northwestern Arkansas, west of the front, were for the most part positive while the tendencies to the east were negative. In western Michigan and southern Wisconsin, west of this front, the pressure tendencies were negative but were in general smaller than the negative tendencies to the east and northeast of the front, where precipitation was falling. On the morning of the 27th, the upper-air front is characterized principally by a wind-shift line from SE. to S., and is already beginning to exhibit signs of a temperature discontinuity. For example Saugeen, which is west of the front, reports rain with a SW. wind and temperature of 44°, while Parry Sound, to the east of the front has rain with a SE. wind and a temperature of 38°. The front becomes indistinct at the ground to the south, although the airplane soundings at Cleveland and Boston show that it exists between these two stations.

The west-east section (fig. 8) for this morning shows that at Omaha the fresh P_c air has displaced the older N_{PC} air at the surface. The temperatures and moisture contents have dropped since the previous morning and the winds are north-northeasterly at the surface and go around to NW. at 1,200 meters and to WNW. at 1,800 meters. This wind shift is accompanied by an increase in temperature from 1° to 4°, and in q from 2.7 to 4.8 grams. Above 1,700 meters the air is still N_{PP} and the flight was terminated at 3,100 meters because of icing conditions in a 10 St. Cu. cloud deck, whose base is at 2,800 meters. The cooling in the N_{PP} current and the condensation in it above 2,800 meters are evidently due to forced ascent over the P_c air coming in at Omaha as a steep wedge, as is seen more clearly on the north-south section for the 27th (fig. 9).

The Cleveland sounding shows the N_{PC} air extending up to 2,000 meters, the temperature and specific humidities being considerably higher than on the previous day. From 1,300 to 2,000 meters, q increases from 3.2 to 6.4 grams, and remains quite high until about 3,500 meters, after which it decreases quite rapidly so that at 5,400 meters q is 0.8 gram. The air above 2,000 meters is evidently the N_{PP} air, although compared to the N_{PP} air at Omaha on the 26th it is cooler level for level, and its moisture contents at lower levels are higher, and at higher levels are much lower. The lower temperatures throughout, and lower specific humidities aloft, are probably due to the Cleveland sounding being well within the N_{PP} current, so that the characteristic coolness and dryness of the N_{PP} air aloft are revealed. Unfortunately, there are no apparent signs at the surface between Cleveland and Boston to show how far eastward the N_{PP} air has advanced, so that it is difficult to determine just how far from the frontal zone the sounding is. The high moisture contents at the lower levels of the N_{PP} air mass are probably caused by the presence nearby of the T_G air that was present at Dallas on the previous morning. This T_G air has evidently moved swiftly up the occluded trough during the preceding 24 hours. The pilot balloon winds at Indianapolis, Ind., at 6 p. m. on the 26th show a SW. current which increases in velocity from 30 miles per hour at 1,200 meters to 52 miles per hour at 4,200 meters. That the upper levels of the N_{PP} air retain their characteristic dryness is probably explained by the fact that at Dallas on the 26th the T_G air was found only up to about 3,000 meters and probably is not much higher to the south of Cleveland. Unfortunately, the lack of an airplane station between Cleveland and Dallas prohibits a more rigorous analysis.

At Boston, the sounding penetrates a layer of N_{PC} air, extending up to 1,000 meters, which has recently passed over the ocean. The moisture contents are higher, and from 1,000 to 1,200 meters there is an inversion of 2.5° through which q decreases from 3.5 to 2.2 grams and the wind shifts from SSE. to S. to SSW. From 1,200 to 1,800 meters the temperature increases 2° and q increases from 2.2 to 2.9 grams. This is evidently a transitional zone between the N_{PC} air below and the tropical air above. Between 2,100 and 4,200 meters the temperature decreases only 7°, and q decreases from 2.9 to 2.2 grams—both very small decreases. This layer is evidently a mixture of the T_s and the N_{TP} air that were present on the previous day. At 5,500 meters the temperature and q are −13° and 1.6 grams, respectively, which is not very much different from −12° and 1.9 grams observed at 5,400 meters at Cleveland on the 26th in the N_{TP} air.

The north-south section at noon of the 27th (fig. 9) shows that at Pembina the P_c air is much warmer level for level than it was the previous evening and that it now possesses considerable stratification, probably on account of subsidence. Two distinct inversions are marked on the sounding, and several isothermal or near-isothermal layers are also found below these inversions.

The Dallas sounding shows that at the surface the N_{PP} air has displaced the N_{PC} air that was present on the previous day. The temperature at about 600 meters has risen from 11° to 18°, and q from 4.2 to 8.0 grams, showing again the increased warmth and moisture of the

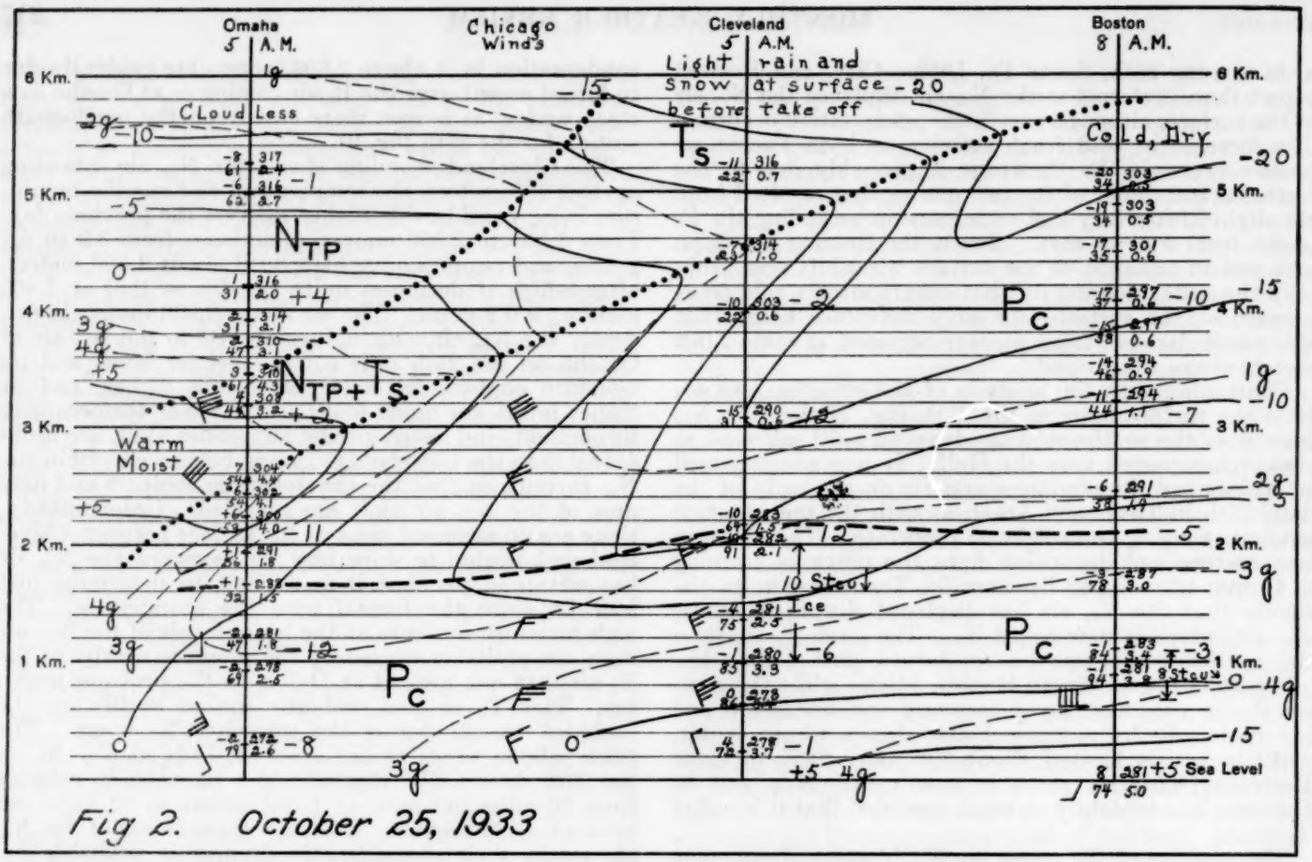


Fig 2. October 25, 1933

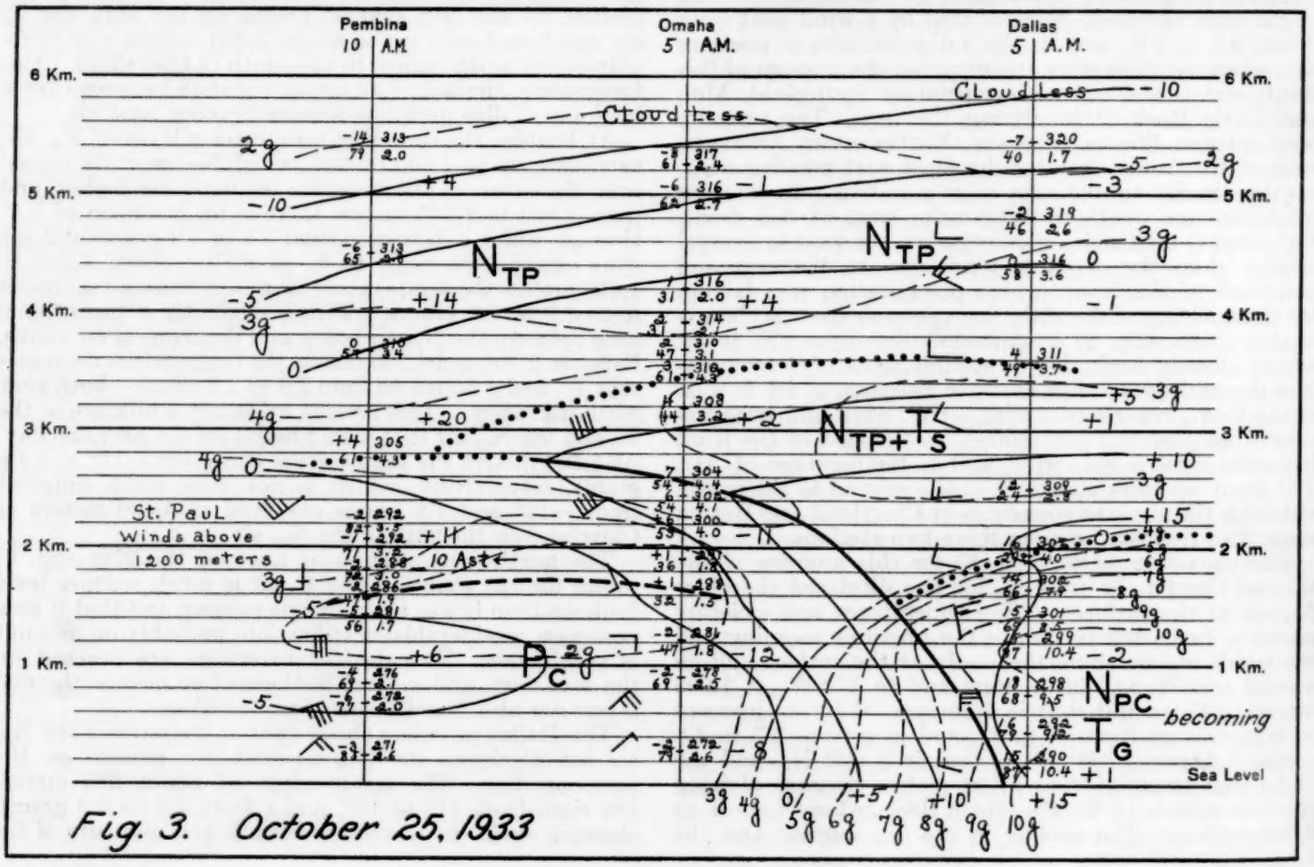
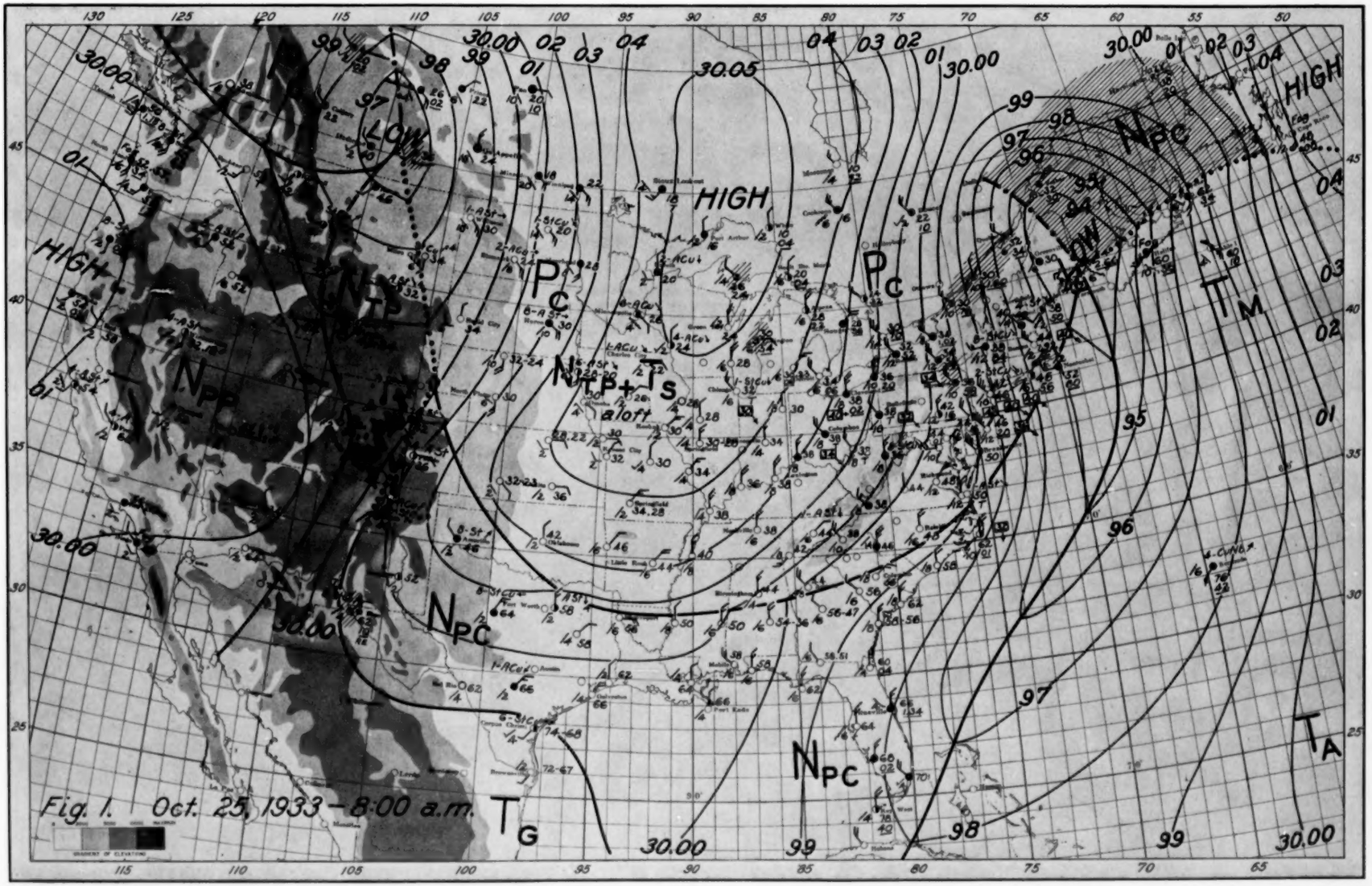


Fig. 3. October 25, 1933


HIGH
LOW
HIGH
LOW
HIGH
NPP
NPP
NPC
NPC
NPC
NTP+TS
aloft
PC
PC
TM
TA
TG
30.00
30.05
99
98
97
96
95
Fig. 1. Oct. 25, 1933 – 8:00 a.m.

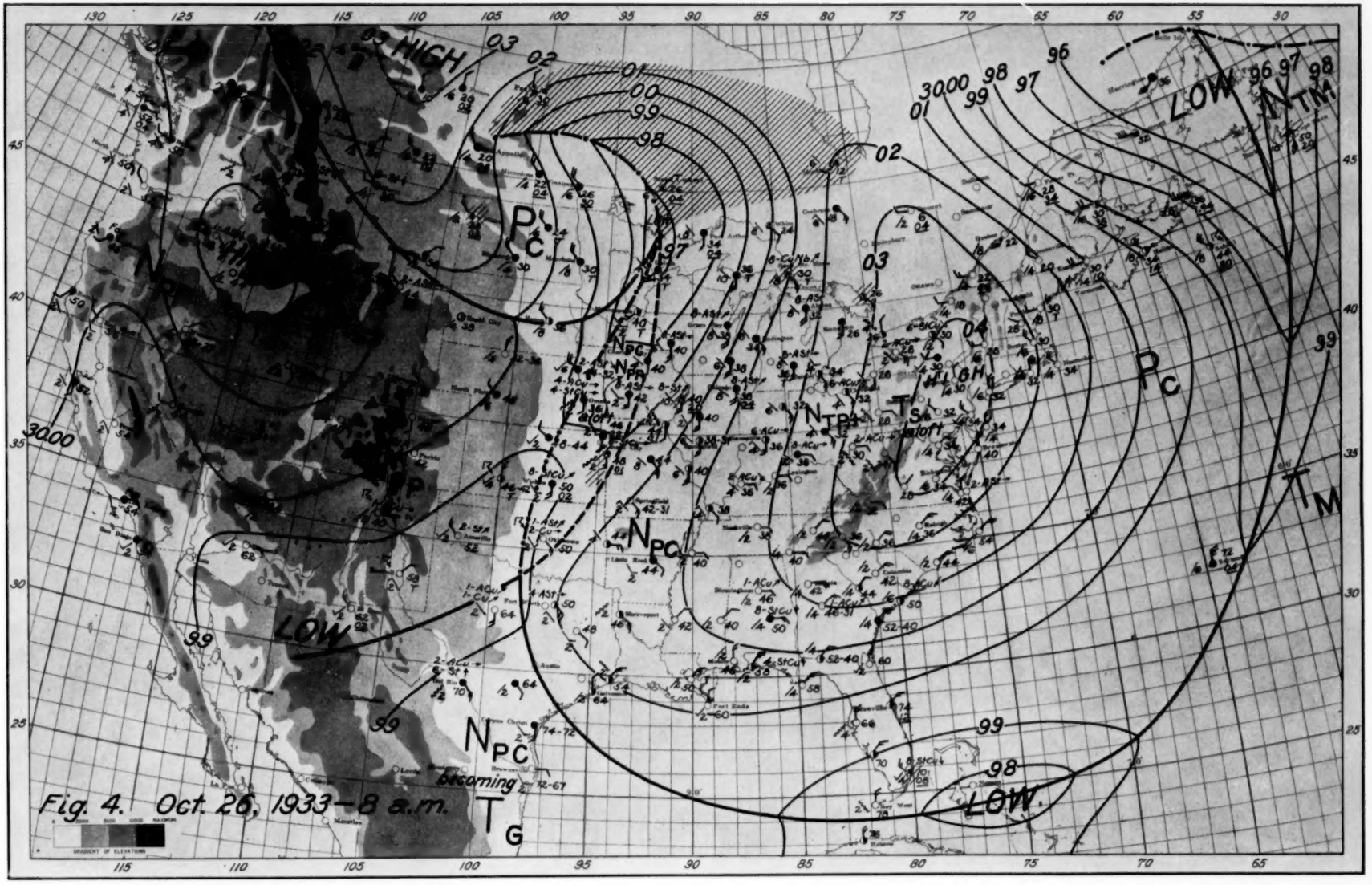


Fig. 4. Oct. 26, 1933—8 a.m.

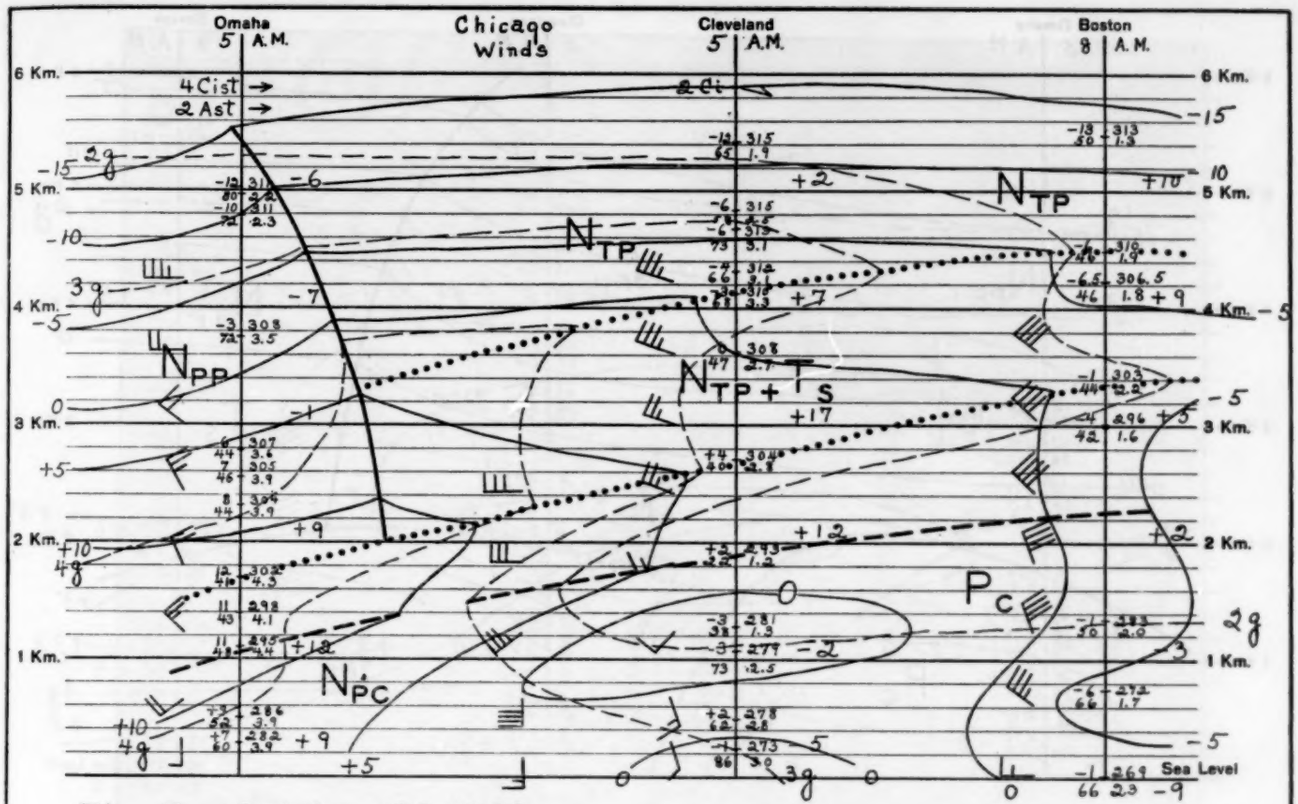


Fig. 5. October 26, 1933

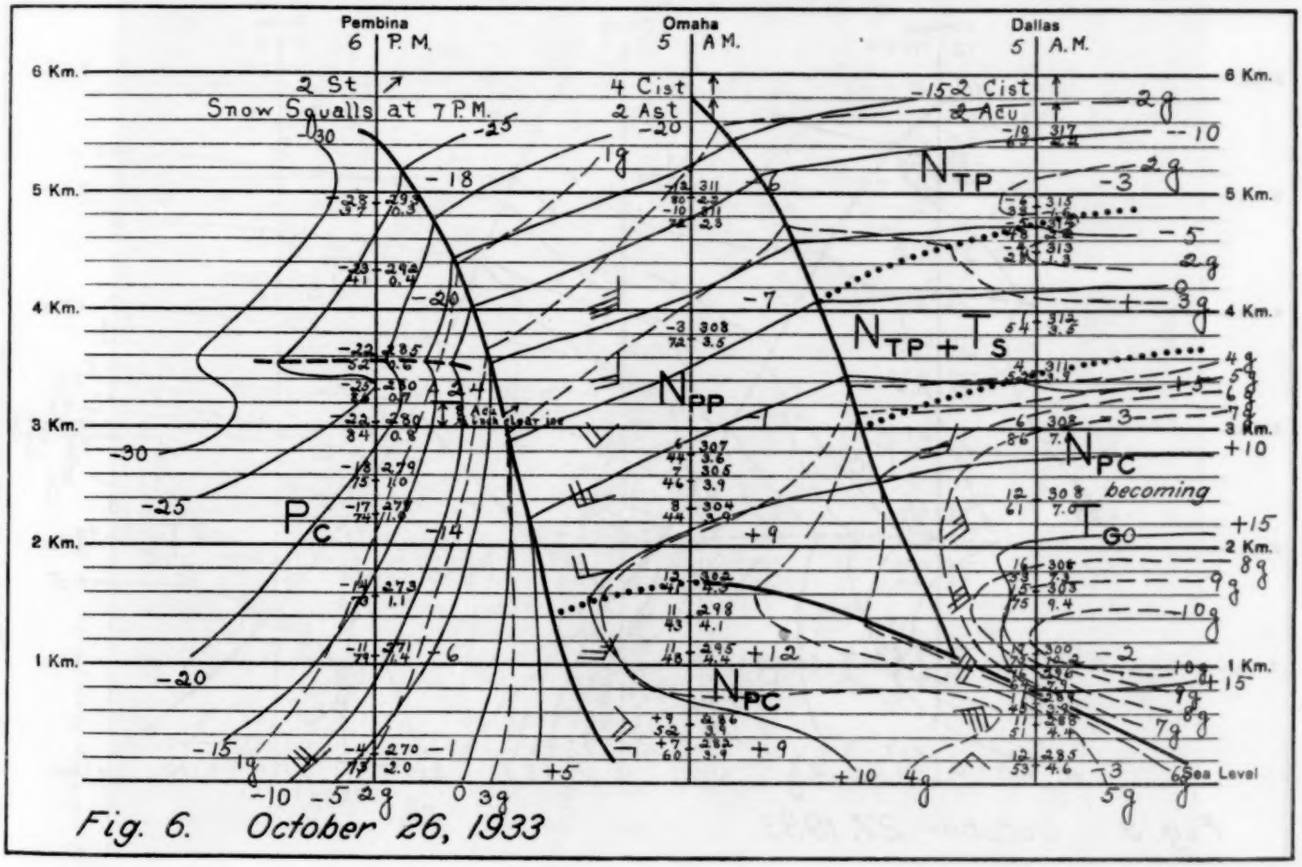


Fig. 6. October 26, 1933

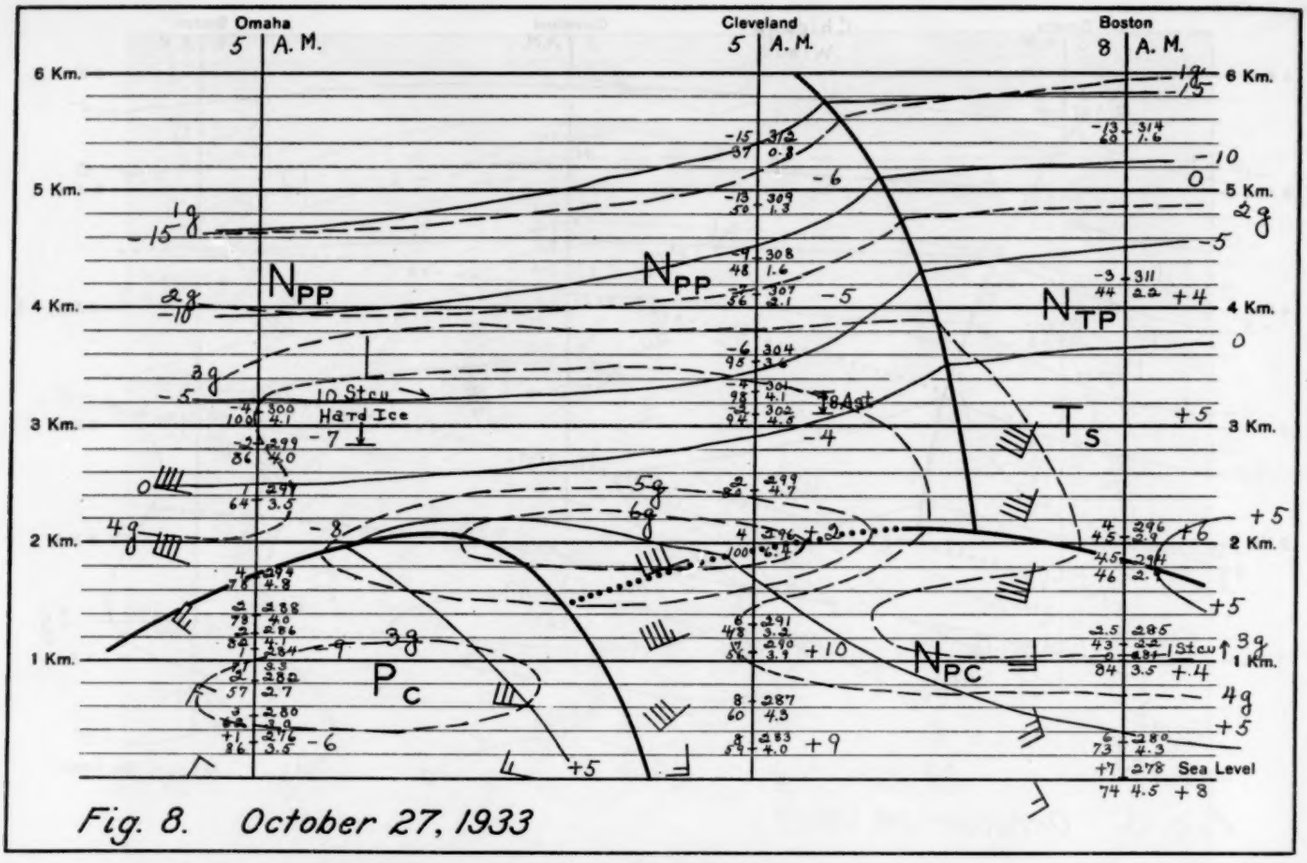


Fig. 8. October 27, 1933

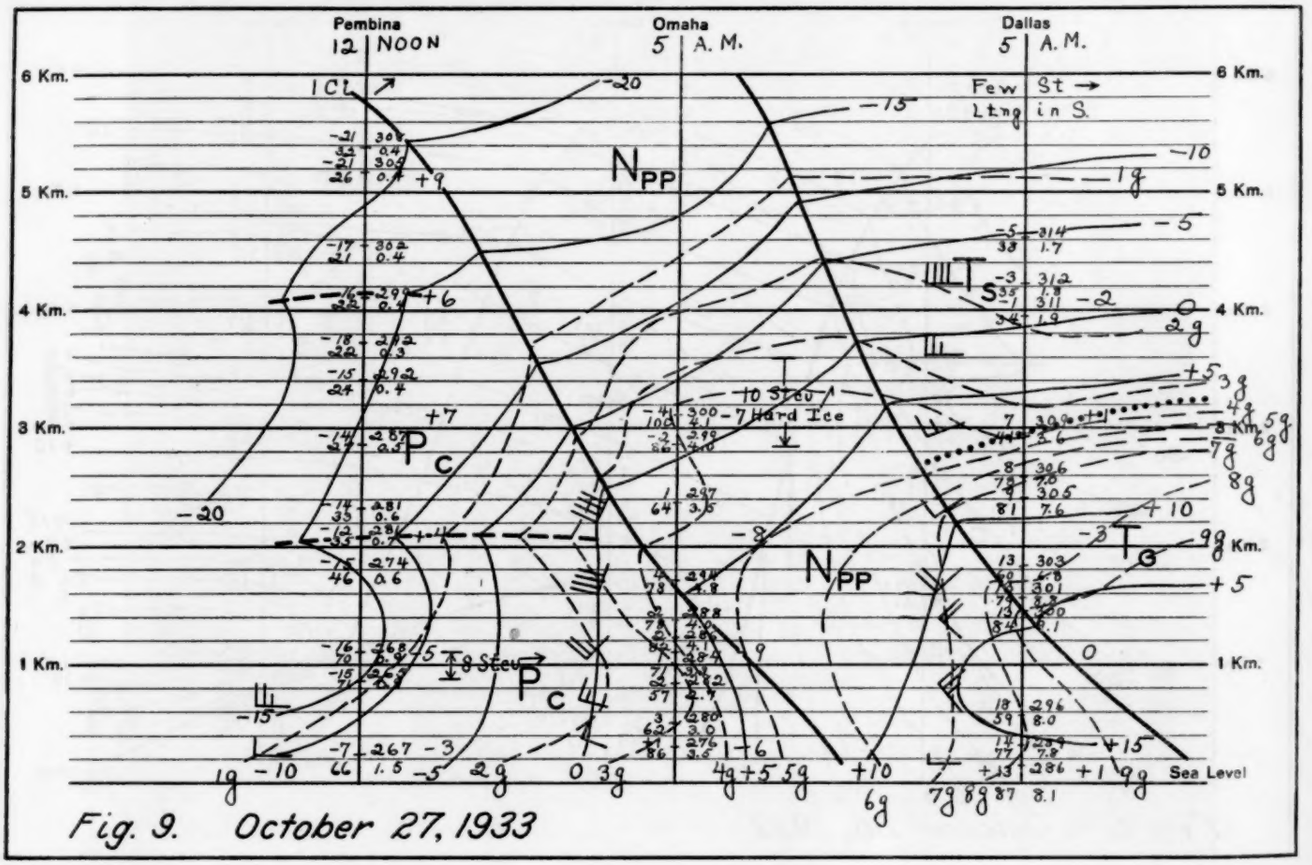
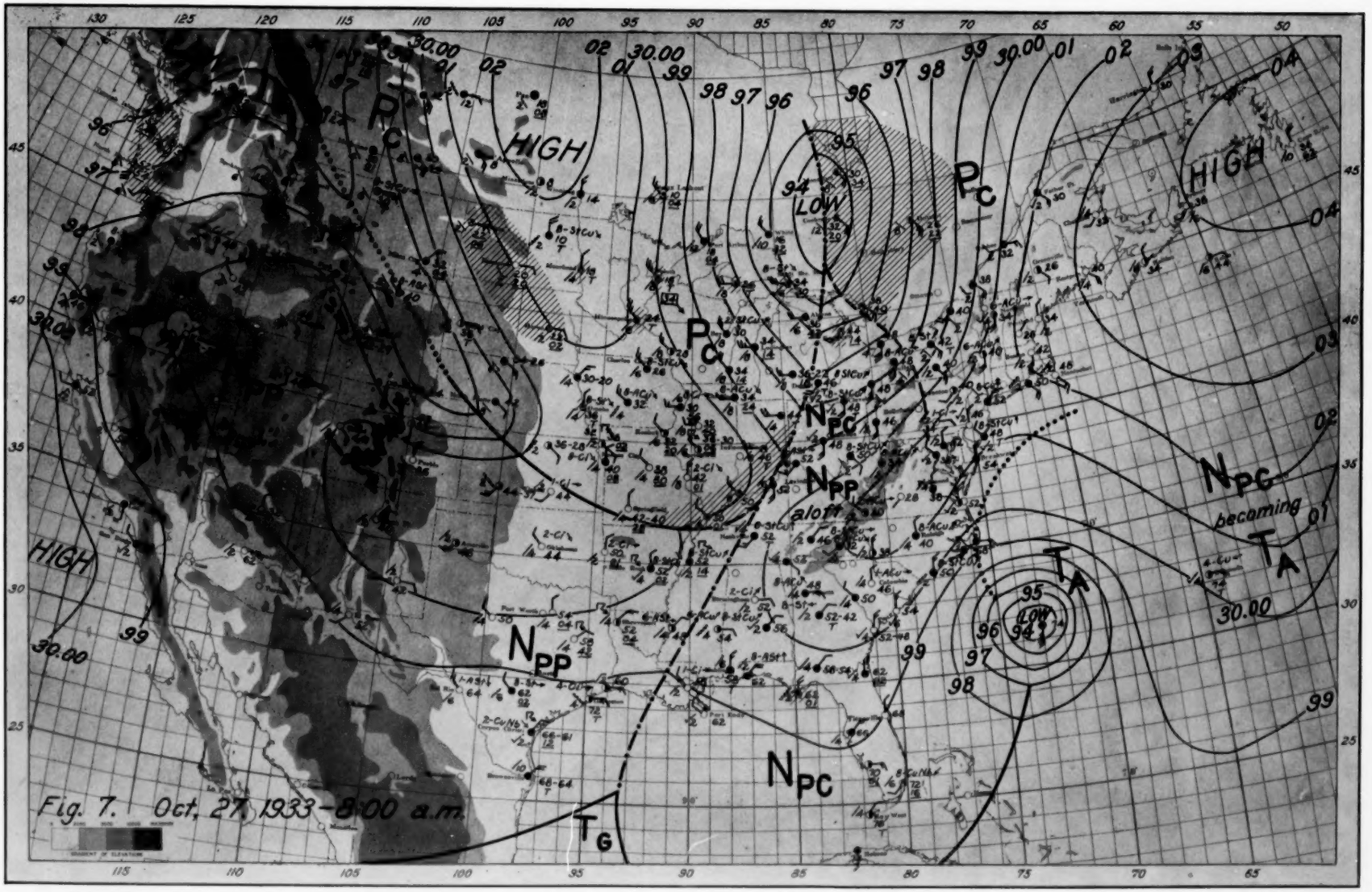


Fig. 9. October 27, 1933


HIGH
Pc
LOW
Pc
HIGH
Pc
NPC
NPP
aloft
NPC becoming TA
HIGH
NPP
TA
LOW
NPC
TG
Fig. 7. Oct. 27, 1933—8:00 a.m.

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N_{PP} air relative to the N_{PC} air. The winds are N. and NE. from the ground up to 1,200 meters. Between 600 meters and 1,400 meters there is evidently a transitional zone between the N_{PP} air and the T_c air. The wind shifts from NE. to NW. and q increases from 8.0 to 9.1 grams and remains quite high until about 2,600 meters. The layer from 2,400 to 3,000 meters shows a moisture decrease from 7.6 to 3.6 grams. Above 3,000 meters, the lapse rate is fairly steep and the moisture content low. This air is the T_s air that has been present above the N_{PC} (T_c) air at Dallas for the past 2 days. Whether or not the N_{TP} air exists above the T_s air as it did previously cannot be said, since the sounding does not extend to sufficient height.

ERRATA IN THE ILLUSTRATIONS

(For explanation of the symbols in the illustrations, see p. 213)

FIGURE 1.—At Bismarck, N.Dak., Huron, S.Dak., and Valentine, Nebr., the pressure tendencies should be steady *falls* instead of steady rises.

FIGURE 4.—At Sault Ste. Marie the pressure tendency should be a steady *fall* instead of a steady rise. The front over the Gulf of St. Lawrence should be a *warm* front instead of an occluded front.

PRELIMINARY MEASUREMENTS OF ULTRA-VIOLET AT BLUE HILL METEOROLOGICAL OBSERVATORY

By RICHARD F. BAKER [1]

[Blue Hill Meteorological Observatory of Harvard University, Milton, Mass., July 1935]

Preliminary measurements of solar ultra-violet radiation were initiated at the Blue Hill Meteorological Observatory in April 1934, with an instrument loaned by the Biological Laboratory of the Long Island Biological Association through the courtesy of Dr. Hugo Fricke.

The sensitive element consisted of a cadmium photoelectric cell, the construction of which merits a brief description. The cell was of the vacuum type, and was constructed of Corex D glass. In shape it was spherical, 2 inches in diameter; attached was a tubular neck 5 inches long, through which passed the anode lead. The anode itself was a nickel ring one-half inch in diameter supported in the center of the cell by the anode lead. The cadmium was deposited directly on the glass surface by a process of successive distillations through a series of small bulbs. To provide a window, the cadmium was then locally distilled off a circular area one-half inch in diameter on the side of the cell. Contact with the cadmium surface was made through a tungsten-Corex D seal in the end of the bulb opposite the neck.

The anode of the cell was connected directly to the fiber of a string electrometer through a metal tube to insure shielding from outside electrical disturbances.

In practice, the electrometer was charged by means of B batteries to 135 volts, the string being at a positive potential with respect to the cadmium surface. After focussing the cell on the source of radiation by means of a pin-hole focussing device, the photoelectric current generated by the radiation was allowed to discharge the electrometer.

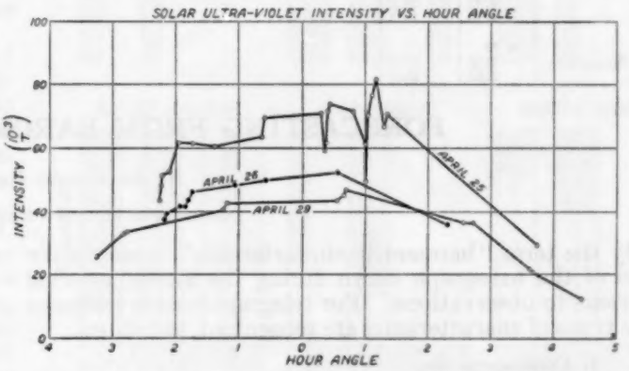
The number of electrons released from a photosensitive surface per unit time is directly proportional to the radiation intensity of given wave-length incident on the surface. Since the rate of discharge of the electrometer is directly proportional to the number of electrons coming to the string from the cell in unit time, it is obvious that the rate of discharge is directly proportional to the radiation intensity of those wave lengths to which the cell is sensitive.

The long wave threshold for cadmium is very close to 3,150 Å; [2] consequently the cell measured no radiation of wave length greater than 3,150 Å. The Corex D glass of the thickness used transmitted no radiation of wave length less than 2,800 Å. Accordingly, the cell was sensitive only to radiation in the spectral range 2,800–3,150 Å. The sensitivity curve of the cell in this range corresponded closely to the sensitivity curve of the human skin to erythema, since the instrument was designed originally for an investigation of the biological effects of solar radiation. The intensities as measured, then, are directly proportional to the erythemal effectiveness of the radiation.

An illuminated scale and telescope were built into the instrument to give a means of measuring the rate of discharge of the electrometer. The rate of discharge was taken as the reciprocal of the time required for a five division fall on the scale. $10^3/t$ was taken for convenience rather than $1/t$, in reducing the data.

The cell aperture consisted of a system of concentric circular brass rings which fitted snugly in a hole in the metal case which held the cell. The aperture used in this investigation was such that when focussed on the solar disk the cell intercepted radiation from a solid angle of 1.8 steradians, or 28.8 percent of the maximum possible area.

The natural leak of the instrument was zero at the time of the observations.



Curves I, II, and III are for three typical days, and represent ultra-violet intensity plotted as a function of hour angle. Table 1 contains the complete set of data, including pertinent comment on the state of the sky at the time of the observations. The marked variations of intensity over a short period, particularly on April 25, are rather remarkable. A cause of these variations cannot be certainly assigned at this time. It seems plausible, however, that absorption and scattering by cloud formations are responsible, at least in some degree.

From the standpoint of the science of meteorology, and also in view of the practical importance to public health of this region of the solar spectrum, it is obvious that the problem of short-time changes in solar ultra-violet intensity merits further investigation.

[1] Department of Physics, University of Rochester, Rochester, N. Y.
[2] Hughes and Du Bridge. Photoelectric Phenomena. New York, 1932.

TABLE 1

Date	Hour angle	$\frac{10^3}{t}$	Comments
1934	*a. m.*		
April 25	2:16	43.3	Wind W. 5-6.
	2:14	48.7	
	2:07	52.6	Visibility 8.
	1:58	61.7	
	1:46	52.6	Clouds 0.
	1:44	61.7	
	1:42	61.7	Blue sky 4.
	1:24	60.6	
	0:39	63.7	
	0:37	69.9	
	p. m.		
	0:19	70.4	Clouds—Ci. fil.
	0:21	59.8	
	0:22	61.7	Ci. unc., Cu., .3.
	0:23	71.4	<15° from sun.
	0:25	71.9	Wind NW.X W. 5-7.
	0:49	71.9	
	1:00	49.5	Cu. near sun.
	1:01	70.4	
	1:10	81.9	Fr.cu. 2° from sun.
	1:12	76.9	
	1:18	66.6	Fr.cu. 10° from sun.
	1:20	70.4	
	3:43	29.5	
	a. m.		
April 26	2:11	37.7	
	2:08	39.8	Cist. in N.
	1:56	41.7	Wind SW. 3-4.
	1:52	41.3	Blue sky 4.
	1:48	43.5	
	1:42	45.2	
	1:03	48.1	
	0:35	50.0	
	p. m.		
	0:33	52.6	
	2:18	36.0	
	a. m.		
April 29	3:15	25.4	Wind NW. 2.
	2:49	33.0	Visibility 9.
	2:47	33.3	Blue sky 4.
	1:15	40.5	
	1:11	42.2	
	p. m.		
	0:33	43.4	Conditions—excellent.
	0:38	45.3	
	0:41	46.5	
	2:33	36.4	
	2:43	37.4	
	3:37	21.4	
	3:42	20.8	
	4:26	12.2	
	a. m.		
Apr. 30	2:42	25.0	
	2:40	25.4	

TABLE 1—Continued

Date	Hour angle	$\frac{10^3}{t}$	Comments
1934	*a. m.*		
Apr. 30	2:39	25.3	
	1:49	31.2	
	1:48	32.4	
	0:51	31.8	
	0:49	36.4	
	p. m.		
	1:26	37.0	
	1:27	36.2	
	1:28	36.5	
	2:32	28.5	Light Ci. fil. near sun.
	p. m.		
May 1	2:05	32.0	
	2:08	31.6	
	2:12	37.3	Thin Ci. film over sun.
	a. m.		
May 5	2:02	63.3	
	2:01	62.5	
	0:59	81.3	Rel. Hum. 95 percent.
	0:56	83.3	Clouds 0.
	0:06	76.9	
	0:04	78.1	
	p. m.		
	0:41	54.6	
	0:43	38.5	Clouds Cu.
	a. m.		
May 8	3:09	29.6	
	1:50	23.9	
	1:48	23.9	
	0:43	22.2	Cist film over 0.7 sky, density 0.
	p. m.		
	1:06	33.4	
	1:07	35.7	
	1:22	41.7	
	a. m.		
May 9	3:05	30.8	Conditions—good.
	3:02	36.9	
	3:00	37.0	
	2:57	38.5	
	2:55	38.5	
	1:55	45.9	
	1:54	46.5	
	1:52	46.3	
	1:32	52.6	
	1:31	49.3	
	0:31	49.7	
	p. m.		
	0:25	49.7	Cu. coming up and increasing.
	0:54	55.5	
	0:56	52.3	Cu. 3° from sun.
	1:00	53.2	

FORECASTING FROM BAROMETRIC CHARACTERISTICS

By ADALBERTO BARRANJARD SERRA

[Meteorological Institute of Brazil, Rio de Janeiro, March 1935]

By the term "barometric characteristic" is meant the form of the barograph curve during the 3-hour interval previous to observations. For telegraphic-code purposes nine types of characteristics are recognized, as follows:

1. Continuous rise.
2. Steady, and now rising.
3. Falling, and now rising.
4. Rising, and now steady.
5. Steady.
6. Falling, and now steady.
7. Steady, and now falling.
8. Rising, and now falling.
9. Continuous fall.

The observations are made at all Brazilian meteorological stations at 9 o'clock Rio de Janeiro legal time, which corresponds to 12 o'clock Greenwich time. The characteristic therefore refers to the period from 6:00 to 9:00. The stations included are the following:

Stations	Belém	F. de Noronha	São Salvador	Cuiabá	Victoria	Tres Lagoas	Rio de Janeiro	Paranaguá	St. Maria
Latitude south	1°28′	3°50′	12°58′	15°36′	20°10′	20°47′	22°54′	25°31′	29°41′
Lontitude west Greenwich	48°27′	32°25′	38°32′	56°06′	40°18′	51°42′	43°10′	48°31′	53°49′
Altitude (meters)	14	106	64	165	32	315	18	9	144

The normal diurnal variation at the various stations is not known; but since in general the pressure is everywhere a maximum about 10 and 22 o'clock, and a minimum at 4 and 16 o'clock, local time, it is easily seen that during the period from 6 to 9 o'clock the normal characteristic should be 1 (continuous rise) at the above stations. The secondary circulations, however, may completely obscure the normal tendency: a rise of the barometer above normal takes place with the appearance of an

anticyclone or the departure of a depression; the appearance of a depression or the departure of an anticyclone may produce a steady or even a falling barometer. Thunderstorms may also, through the classic "crochet d'orage", profoundly affect the characteristic.

In the northern part of the country, variations in the characteristics are due to oscillations of the high-pressure center over the Atlantic, or of the continental depression. These movements are also the cause of weather changes, and hence it is reasonable to look for a connection between the weather and the barometric characteristics. Furthermore, because of differences in topography, latitude, continentality, etc., given types of characteristics will produce different weather conditions at different stations.

The present investigation is based on an examination of 243 weather maps in the years 1930-33, months of January (summer) and July (winter). The probability (in percent) that the weather will remain fair, uncertain, or rainy, for 24 hours after the observations, have been determined for each type of characteristic; characteristics of rare occurrence were not taken into consideration. The results are shown in the accompanying figures, which are self-explanatory.

At F. de Noronha, São Salvador, and St. Maria there is greater probability of rain in the winter than in the summer; on the contrary, rain is more frequent in the summer at Belém, Cuyabá, Tres Lagoas, Rio de Janeiro, Victoria, and Paranaguá.

In summers, at the coast stations (Belém, São Salvador, Victoria, Rio de Janeiro, and Paranaguá) rain is more probable with characteristic 1 (the only exception is found in Paranaguá), and less probable with characteristics 4 and 5. The more frequent formation of local thundershowers under inactive isobaric conditions with a normal diurnal variation, perhaps explains the greater frequency of rain under characteristic 1.

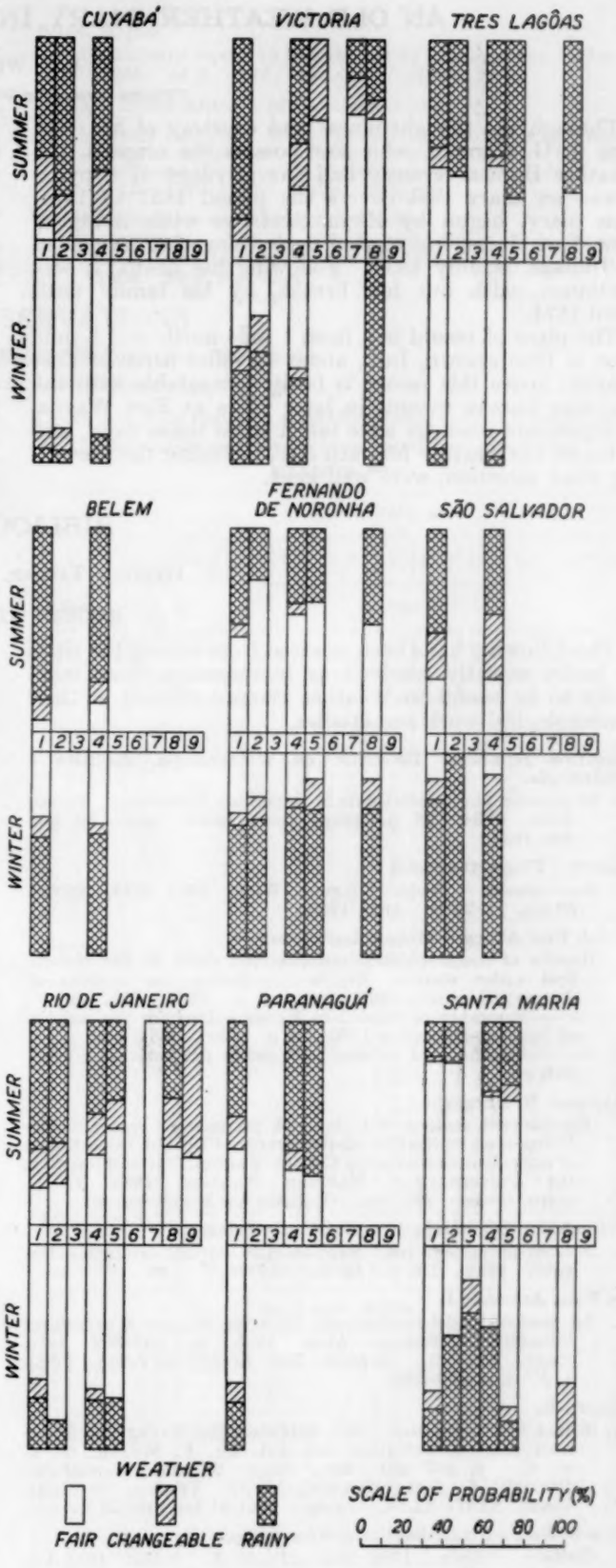
A steady barometric curve at São Salvador, Victoria, and Rio de Janeiro, accompanying a diminution of the Atlantic HIGH, indicates a probability of good weather.

In Paranaguá, which is more subject to the activity of the secondary circulations because of its latitude, steady characteristics, due to the passage of depressions, indicate bad weather. In the winter, characteristics 1 and 2 still give the highest probabilities of rain, due to the more frequent occurrence of anticyclones (with the exception, naturally, of Belém).

At the continental stations (Tres Lagoas, Cuyabá, St. Maria) rain is more probable with characteristics 2, 3, 4, and 5. In the summer these characteristics signify an alteration of the normal diurnal variation, and indicate a greater activity of the continental depression at the first two stations—that is, a great increase of heat, leading to thundershowers and heavy rains in the summer; in St. Maria they accompany the appearance of depressions and are likewise inclined to produce rain in any period of the year. During the winter, in Cuyabá and Tres Lagoas, rain is very infrequent because of the absence of local thundershowers.

Finally, the probabilities of various weather conditions are more or less equal, no matter what the type of characteristic, at Farrando de Noronha.

Although we have not given a complete explanation of the connection between barometric characteristics and weather conditions, we regard the probabilities found to be helpful in short-period weather forecasting.



AN OLD WEATHER DIARY IN NORTHEASTERN INDIANA

By B. B. WHITTIER

[Weather Bureau, Fort Wayne, Ind., July 1935]

Through the thoughtfulness and courtesy of Mr. and Mrs. J. G. Carman, who now possess the original, the Weather Bureau recently had the privilege of copying a weather diary that covers the period 1837 to 1874. This diary, begun by Rapin Andrews while living in New York State, was carried on by him after he moved to Indiana in July 1839. Following his death, it was continued, with but few breaks, by his family until April 1874.

The place of record is a farm 1 mile north and ½ mile west of Huntertown, Ind., about 12 miles north of Fort Wayne; hence this record is fairly comparable with the Weather Bureau records in later years at Fort Wayne. Temperature readings were taken three times daily, and notes on the weather for each day, including the prevailing wind direction, were well kept.

The highest temperature noted in the diary was 102° at noon, July 9, 1846. This compares favorably with the later official record at Fort Wayne of 106° on July 22, 1934. Numerous cold spells are noted in the diary. The lowest temperature recorded was −34° at 7 a. m., January 29, 1873. The lowest on the Fort Wayne official record (since 1911) is −24° on January 12, 1918. The famous (or infamous!) "cold New Year's Day" of 1864 is found to deserve its reputation, for its noon temperature was −16°. It is interesting to note that the monthly extremes of high temperatures largely center around the 1840's, while the extremes of cold are often in the 1860's or early seventies.

Copies of this early record are now on file in the Weather Bureau offices at Washington, D. C., and Indianapolis, and Fort Wayne, Ind.

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RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies.

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Austria. Flugwetterdienst

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——— Summary of rainfall in Uganda protectorate. 1932. 36½ cm.

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SOLAR OBSERVATIONS

SOLAR RADIATION MEASUREMENTS DURING JULY 1935

By IRVING F. HAND, *Assistant in Solar Radiation Investigations*

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged close to the July normals at Washington and Lincoln, and slightly above normal at Madison.

With the reopening of the pyrheliometric stations at Pittsburgh and La Jolla, the list of stations in table 2 is the largest in the history of the bureau. Owing to the relocation of the pyrheliometer at Pittsburgh from an urban to a suburban site, it has been deemed best to wait until new normals have been established before giving weekly departures of solar and sky radiation. New normals will also be necessary at La Jolla, for the reason that some doubt is held concerning the accuracy of the records obtained during the last few months with the old instrument which had absorbed some water-vapor. The Scripps Institution now has an hermetically-sealed thermoelectric pyrheliometer, and excellent records are to be expected from now on. Practically all stations in the central portion of the United States showed an excess in the total solar and sky radiation during the month. However, Washington, Chicago, Miami, New Orleans, and Riverside—all located near the seacoast or on the Great Lakes—showed a deficiency.

The red and the yellow glass filters used in turbidity measurements were tested during July by the National Bureau of Standards and found to have identically the same transmission coefficients that they had at the initial test.

Polarization measurements obtained on 4 days at Washington give a mean of 56 percent with a maximum of 61 percent on the 11th. At Madison observations taken on 8 days give a mean of 58 percent with a maximum of 66 percent on the 6th. All of these values are close to the July normals.

TABLE 1.—*Solar radiation intensities during July 1935*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance: 8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	c	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	*c*
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
July 3	11.81					1.16					9.14
July 11	19.23	0.61	0.68	0.86	1.02						16.79
July 12	20.57	.44	.57	.71	.88	1.04					17.96
July 15	18.59			.60							16.79
July 18	18.59	.63	.78								18.59
July 20	18.59				1.18						16.20
July 29	16.79			.51							14.10
July 30	10.97		.90	1.06	1.20	1.32					11.74
Means		.56	.73	.75	1.07	1.17					
Departures		−.02	+.05	−.03	+.15	−.04					

TABLE 1.—*Solar radiation intensities during July 1935*—Continued

[Gram-calories per minute per square centimeter of normal surface]

MADISON, WIS.

Date	Sun's zenith distance: 8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass: A. M.					P. M.				Local mean solar time
	c	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	*c*
	mm	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm*
July 5	19.23			0.91							17.37
July 6	16.79		0.95	1.08	1.24	1.42					17.96
July 8	12.24	0.87	.96	1.07	1.23	1.40					14.60
July 10	16.20		.74								16.79
July 12	15.65				1.28	1.47					12.68
July 13	13.61			1.10	1.24	1.43					12.24
July 16	12.24					1.31					13.61
July 17	11.38			.99	1.17	1.36					14.10
July 19	16.79		.62	.77	.99	1.27					15.65
July 25	17.37				1.14	1.38					17.37
July 26	15.65				1.05						18.62
July 29	14.60		.87	.93		1.39					15.11
Means		(.87)	.83	.98	1.17	1.38					
Departures		+.17	+.03	+.05	+.10	+.07					

LINCOLN, NEBR.

July 1	18.59							0.65	0.43	0.34	21.28
July 2	19.89		0.53	0.71	0.94	1.24		.70	.57	.46	18.59
July 3	17.37		.83	.98	1.14	1.37					17.96
July 5	21.28					1.26	1.04	.88	.74	.61	20.57
July 8	18.74					1.30	1.04	.84	.67		17.37
July 10	21.28				1.10	1.29	.98	.75	.60	.50	16.20
July 12	16.79					1.33	1.13	.97	.83	.72	13.61
July 13	12.24	0.77	.88	.99	1.17	1.29					12.68
July 15	14.10		.91	1.02	1.21	1.42	1.18	1.00	.84	.72	10.97
July 16	14.10	.82	.93	1.06	1.23	1.39	1.15	.99	.87	.73	17.14
July 17	15.65		.79	.96	1.14	1.38			.77	.66	12.24
July 18	14.60		.79	.93	1.11	1.38					12.68
July 19	14.60	.45	.55	.70	.92	1.30					14.60
July 20	20.57	.50	.66	.84	1.06	1.35					15.11
Means		.64	.76	.91	1.10	1.33	1.09	.85	.70	.59	
Departures		−.03	−.02	−.01	+.02	+.02	+.07	+.02	.00	+.01	

BLUE HILL, MASS.

July 1	8.8				1.07	1.43					9.9
July 2	8.8				1.28	1.45					6.3
July 3	9.2					1.43	1.11	1.03			7.6
July 4	12.8				1.14	1.17					11.5
July 5	16.9				1.11	1.19					16.4
July 8	16.7				1.07	1.28					17.5
July 10	17.5				1.06	1.14	.99				14.7
July 11	17.5				.73	1.13					16.4
July 12	18.8				.80	1.04					16.4
July 17	16.9					1.10					15.8
July 18	18.2					1.28	.84				16.4
July 20	17.5					1.02	.84				14.7
July 23	20.1					1.11					18.8
July 26	9.9					1.41	1.15				8.8
July 27	11.9				1.18	1.35	1.11				9.2
July 28	10.3			1.03	1.20	1.42	1.21	1.07			9.6
July 30	11.5				1.23	1.38					9.6
Averages				1.03	1.08	1.25	1.04	1.05			

*Extrapolated.

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Mount Washington	Friday Harbor	Ithica	San Juan
	Gram calories per square centimeter																	
1935	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
July 2	456	497	622	412	556	769	592	596	563	665	478	394	622	558	.....	484	503	799
July 9	472	601	633	547	585	683	550	538	622	619	513	416	540	465	.....	567	537	771
July 16	469	570	604	544	424	726	594	380	610	574	460	263	584	460	.....	683	567	728
July 23	521	499	600	511	460	741	468	348	640	566	496	314	586	521	.....	497	472	803
	Departure from weekly normals																	
July 2	−83	−30	+40	+46	+112	+64	.....	+137	−40	.....	−41	+17	+10	.....	.....	.....	.....	.....
July 9	−46	+67	+54	−94	−61	−17	.....	+105	+17	.....	−26	+34	−69	.....	.....	.....	.....	.....
July 16	−38	+51	+26	−140	+2	+41	.....	−21	0	.....	−62	−103	−16	.....	.....	.....	.....	.....
July 23	+10	−8	+47	−106	+34	+80	.....	−42	+68	.....	−41	−36	−8	.....	.....	.....	.....	.....
	Accumulated departures on July 29																	
	−3,941	−8,050	−7,021	−700	+3,234	+3,262	.....	+2,870	+1,379	.....	−3,465	−1,568	−4,753	.....	.....	.....	.....	.....

TABLE 3.—*Total, I_m, and screened, I_y, I_r, solar radiation intensity measurements, obtained during July 1935, and determinations of the atmospheric turbidity factor, B, and water-vapor content, w=depth in millimeters, if precipitated*

AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{m-y}	$\frac{I_{w=0}}{1.94}$ Percentage of solar constant	$\frac{I_{w=0}-I_m}{1.94}$ Percentage of solar constant	w	Air-mass type
July 11, 1935	° ′	*m*	*gr. cal.*	*gr. cal.*	*gr. cal.*						*mm*	
4:23 a. m.	32 10	1.87	1.100	0.770	0.592	0.044	0.050	0.047	76.4	7.8	11.0	N_{PC}
4:18 a. m.	33 00	1.83	1.118	.773	.594	.046	.050	.048	75.6	6.6	9.0	

Atmospheric conditions, July 11. Temperture 18° C.; wind, N-11; visibility, 30 miles; blueness of sky, 5; polarization, 61 percent.

TABLE 3.—*Total, I_m, and screened, I_v, I_r, solar radiation intensity measurements, obtained during July 1935, and determinations of the atmospheric turbidity factor, B, and water-vapor content, w=depth in millimeters, if precipitated*—Continued

Thermopheric turbidity

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

Date and hour angle	Solar altitude	Air mass	I_m	I_v	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{v-r}}$	β_{mean}	$\frac{I_{w-v}}{1.91}$	$\frac{I_{w-v}-I_m}{1.94}$	w	Air-mass type
									Percentage of solar constant			
July 1, 1935	° ′	*m*	*gr. cal.*	*gr. cal.*	*gr. cal.*						*mm*	
2:49 p. m.	50 15	1.30	1.370	0.954	0.748	0.033	0.048	0.040	82.6	9.4	10.8	P_s
July 2												
4.27 a. m.	32 10	1.87	1.290	.884	.724	.025	.074	.050	75.2	6.6	7.0	N_{ps}
0.29 a. m.	69 54	1.06	1.420	.965	.766	.036	.052	.044	84.9	9.1	14.0	
July 3												
0.33 a. m.	69 34	1.06	1.410	.949	.749	.034	.052	.043	85.0	9.3	14.4	N_{ps}
2:28 p. m.	54 29	1.23	1.300	.892	.697	.054	.073	.064	79.6	10.5	11.3	
5:19 p. m.	22 33	2.61	1.080	.778	.634	.046	.067	.056	67.2	9.5	7.2	
July 4												
1:33 a. m.	62 39	1.12	1.170	.799	.629	.101	.134	.118	73.4	11.0	12.5	N_{ps}
0:18 a. m.	70 25	1.06	1.170	.799	.629	.108	.148	.128	75.0	12.6	13.5	
July 5												
4:55 a. m.	27 23	2.17	1.030	.729	.584	.063	.076	.070	68.8	14.2	7.2	T_G
0:19 p. m.	71 10	1.06	1.190	.807	.633	.102	.167	.134	73.8	10.4	13.2	
July 11												
4:11 a. m.	35 20	1.73	.824	.570	.428	.113	.118	.116	65.5	11.6	8.2	N_{ps}
0:10 p. m.	69 47	1.06	1.110	.750	.608	.149	.179	.164	70.6	11.5	13.4	
2:48 p. m.	39 44	1.56	1.130	.783	.609	.070	.075	.072	74.6	14.4	9.3	
4:23 p. m.	32 19	1.87	1.030	.723	.579	.085	.113	.099	65.1	10.3	8.5	
July 18												
3:21 a. m.	43 41	1.45	1.050	.727	.598	.130	.158	.144	66.0	10.1	9.6	T_G
July 20												
2:16 p. m.	64 00	1.11	1.006	.722	.583	.187	.175	.181	67.7	14.1	9.8	
3:23 p. m.	42 08	1.49	.976	.700	.560	.139	.150	.144	65.1	13.1	9.7	
July 23												
2:45 a. m.	49 28	1.31	.971	.697	.568	.170	.196	.183	63.7	5.1	9.8	T_G
1:52 a. m.	58 15	1.18	1.041	.747	.598	.188	.182	.185	65.6	3.9	9.7	
July 27												
5:01 a. m.	23 31	2.50	1.090	.790	.648	.048	.055	.052	70.9	13.0	5.8	P_p and P_s
3:25 a. m.	41 50	1.53	1.242	.859	.687	.049	.075	.062	76.1	10.1	8.7	
1:42 a. m.	58 28	1.18	1.375	.933	.736	.035	.054	.044	83.1	10.0	11.7	
0:03 a. m.	66 57	1.09	1.345	.903	.722	.067	.001	.034	85.7	14.3	13.0	
0:57 p. m.	64 02	1.11	1.237	.859	.682	.098	.107	.102	76.6	10.9	12.3	
4:48 p. m.	25 55	2.28	1.075	.771	.663	.061	.090	.076	66.1	9.0	6.0	
July 28												
5:14 a. m.	21 00	2.77	1.065	.781	.653	.051	.076	.064	64.0	7.1	4.4	N_{ps}
4:01 a. m.	44 29	1.43	1.237	.864	.687	.075	.115	.095	72.7	6.6	8.3	
1:44 a. m.	58 01	1.18	1.390	.933	.741	.029	.065	.047	82.9	8.7	9.5	
1:19 a. m.	61 23	1.14	1.394	.938	.746	.029	.069	.049	83.2	8.7	12.0	
0:06 p. m.	66 44	1.09	1.399	.947	.752	.057	.073	.065	81.5	6.7	12.0	
1:10 p. m.	62 27	1.13	1.444	.967	.761	.019	.046	.032	85.8	8.7	12.0	
3:08 p. m.	44 08	1.44	1.340	.913	.722	.030	.055	.042	81.0	9.4	9.6	
5:29 p. m.	18 15	3.18	1.080	.786	.643	.031	.050	.040	68.1	10.3	6.5	
July 30												
3:48 a. m.	36 40	1.67	1.282	.872	.699	.028	.062	.045	78.7	9.6	8.2	N_{ps}
2:15 p. m.	53 00	1.25	1.325	.916	.723	.050	.065	.058	80.6	10.2	11.1	
2:33 p. m.	50 01	1.30	1.325	.916	.723	.047	.060	.054	80.4	10.0	10.9	

Atmospheric conditions during solar radiation measurements. Blue Hill Observatory of Harvard University

Date and time from apparent noon	Air temperature	Wind (Beaufort scale)	Visibility (scale 0-10)	Sky blueness	Cloudiness and remarks
July 1935	°C.				
1;2:26 p. m.	22.78	NE 2	9	10	3 Ci, 1 Cu, light haze in N.
2;0:26 a.m.	20.56	E 3	9	10	6 Ci, few Cu, light haze in N and W.
4;3:02 a.m.	22.22	SW 5	9	7	4 Acu, light haze.
4;0:36 a.m.	23.89	SW 5	8	6	3 Acu, light haze.
8;3:51 p. m.	23.89	SSE 5	9	9	Few Acu, 6 Cu, light water haze.
10;3:28 p. m.	25.00	SW 1	8-9	10	3 Acu, 3 Cu, light haze in N.
11;2:34 p.m.	27.78	S 1 [1]	8	8	3 Ci, 4 Cu, light haze.
12;2:42 p.m.	30.56	WSW 5	8	8	3 Cu, Frcu, moderate haze.
17;2:51 a.m.	22.22	W 2	7	7	2 Ci, 3 Cu, heavy water haze.
18;2:30 p.m.	28.33	WSW 5	8	8	7 Cu, Frcu, moderate haze.
20;4:40 a.m.	21.56	NNE 3	7	4	Ci haze.
20;3:42 a.m.	22.22	NNE 3	7	------	Ci haze, Cu increasing.
20;3:23 p.m.	21.67	NE 3	7	------	Light haze.
23;2:51 a.m.	27.78	WxS 4	8	4	Ci haze.
26;0:04 p. m.	20.68	NE 5	9	7	Clear.
26;3:52 p.m.	21.56	E 2	9	------	1 Ci, Cu.
27;4:58 a. m.	16.94	N 2	9	6	Few Ci in E.
27;1:34 a. m.	16.11	NNE 2	9	6	Clear.
27;0:58 p. m.	15.56	NE 3	9	6	Cu on horizon.
28;3:54 a. m.	20.00	SE 2	9	4	Few Ci in E.
28;1:32 a.m.	21.67	SE 2	9	9	2 Ci, No haze.
28;0:08 a.m.	22.50	SE 2	9	9	3 Ci. No haze.
28;2:46 p. m.	24.44	SSE 3	9	9	2 Ci, few Acu, few Cu, no haze.
30;2:24 a. m.	22.11	N 5-6	9	6	Ci, highest near sun.
30;1:10 p. m.	23.33	NE 2	9	6	Thin Ci?

[1] Wind direction variable.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy Superintendent U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measure from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. The total area for each day includes spots and groups]

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1935	h m	°	°	°				
July 1	9 4	+24.0	308.0	−23.5	-------	1,124	1,124	Harvard.
July 2	14 10	+35.0	302.9	−25.0	-------	772	772	U. S. Naval.
July 3	11 4	−80.0	176.4	+25.0	46	-------	-------	
		+46.0	302.4	−25.5	-------	556	602	Do.
July 4	10 30	−71.0	172.5	+27.0	276	-------	-------	
		+64.5	308.0	−22.0	-------	375	651	Harvard.
July 5	11 37	−75.0	154.6	−35.0	-------	77	-------	U. S. Naval.
		−56.0	173.6	+25.0	62	-------	-------	
		+75.0	304.6	−26.0	-------	278	417	
July 6	10 9	−62.0	155.2	−34.0	-------	247	-------	Do.
		−44.0	173.2	+24.5	46	-------	293	
July 7	11 58	−48.0	154.9	−34.0	-------	247	-------	Do.
		−30.0	172.9	+24.5	46	-------	293	
July 8	9 50	−69.0	121.9	−19.5	224	-------	-------	Mt. Wilson.
		−51.0	139.9	+22.0	-------	30		
		−32.0	158.9	−34.0	-------	257	-------	
		−18.0	172.9	+25.0	48	-------	559	
July 9	10 58	−58.0	119.0	−19.0	139	-------	-------	U. S. Naval.
		−37.0	140.0	+22.0	-------	62	-------	
		−19.5	157.5	−34.0	-------	154	-------	
		−4.0	173.0	+24.0	46	-------	401	
July 10	12 4	−44.0	119.2	−19.0	123	-------	-------	Do.
		−23.0	140.2	+22.0	-------	46	-------	
		−7.0	156.2	−34.0	108	-------	-------	
		+9.5	172.7	+24.0	31	-------	308	
July 11	11 47	−30.0	120.1	−20.0	139	-------	-------	Do.
		−9.0	141.1	+21.5	-------	46	-------	
		+7.0	157.1	−35.0	93	-------	-------	
		+21.5	171.6	+24.0	15	-------	293	
July 12	10 55	−65.0	72.4	−28.0	-------	62	-------	Do.
		−19.0	118.4	−20.0	139	-------	-------	
		+5.0	142.4	+21.0	-------	31	-------	
		+12.0	149.4	−20.0	123	-------	-------	
		+19.5	156.9	−35.5	123	-------	-------	
		+35.0	172.4	+24.5	15	-------	493	
July 13	12 14	−51.0	72.4	−28.0	-------	139	-------	Do.
		−4.0	119.4	−20.0	123	-------	-------	
		+35.0	158.4	−35.0	93	-------	-------	
		+48.0	171.4	+25.0	15	-------	370	

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time	Heliographic			Area		Total area for each day	Observatory
		Diff. in longitude	Longitude	Latitude	Spot	Group		
1935	h m	°	°	°				
July 14	10 59	−38.0	72.8	−28.0	-------	216	-------	Do.
		+9.0	119.8	−20.0	139	-------	-------	
		+45.0	155.8	−35.0	93	-------	448	
July 15	13 16	−75.0	21.4	−18.5	15	-------	-------	Do.
		−24.0	72.4	−28.5	-------	185	-------	
		+22.0	118.4	−20.0	123	-------	-------	
		+59.0	155.4	−35.0	77	-------	400	
July 16	11 27	−60.0	24.1	−19.0	62	-------	-------	Do.
		−11.0	73.1	−28.5	-------	185	-------	
		+36.0	120.1	−19.5	123	-------	-------	
		+71.0	155.1	−35.0	62	-------	432	
July 17	11 40	−49.0	21.8	−19.0	46	-------	-------	Do.
		+4.0	74.8	−28.0	-------	185	-------	
		+49.0	119.8	−19.5	123	-------	354	
July 18	11 14	−35.5	22.3	−19.0	31	-------	-------	Do.
		+16.5	74.3	−28.5	-------	185	-------	
		+62.0	119.8	−19.5	123	-------	339	
July 19	11 35	−28.5	15.9	+29.0	-------	123	-------	Do.
		−21.0	23.4	−19.0	31	-------	-------	
		+29.0	73.4	−28.5	-------	185	-------	
		+76.0	120.4	−19.5	108	-------	447	
July 20	12 12	−15.0	15.8	+29.0	-------	278	-------	Do.
		+44.0	74.8	−28.0	-------	247	525	
July 21	12 40	−1.5	15.8	+29.0	-------	247	-------	Do.
		+60.0	77.3	−28.0	-------	185	432	
July 22	11 19	+12.5	17.3	+29.0	-------	247	-------	Do.
		+73.0	77.8	−28.0	-------	93	340	
July 23	10 57	+25.0	16.8	+29.0	-------	247	247	Do.
July 24	9 45	−42.0	297.2	−24.0	3	-------	-------	Mt. Wilson.
		+38.0	17.2	+29.0	-------	334	337	
July 25	11 14	+52.0	17.2	+28.5	-------	247	247	U. S. Naval.
July 26	13 30	+64.0	14.7	+28.0	-------	264	-------	Mt. Wilson.
		+80.0	30.7	+17.0	10	-------	274	
July 27	11 10	+69.0	7.8	+28.0	123	-------	123	U. S. Naval.
July 28	11 30	+85.0	10.3	+28.0	84	-------	84	Mt. Wilson.
July 29	11 4		No spots					U. S. Naval.
July 30	11 41	−70.0	188.8	−19.0	-------	77	77	Do.
July 31	13 40	−56.0	188.5	−18.0	-------	77	77	Do.

Mean daily area for 31 days, 379.

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, JULY 1935

(Dependent alone on observations at Zurich and its station at Arosa)

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich, Switzerland]

July 1935	Relative numbers	July 1935	Relative numbers	July 1935	Relative numbers
1	41	11	*a* 44	21	36
2	29	12	*Ec* 59	22	32
3	29	13	63	23	30
4	24	14	*a* 51	24	29
5	*d* 28	15	49	25	23
6	29	16	49	26	19
7	22	17	*a* 47	27	11
8	*d* 50	18	46	28	8
9	44	19	*Ec* 51	29	0
10	38	20	*b* 60	30	*Ec* 8
				31	8

Mean, 31 days=34.1.

a=Passage of an average-sized group through the central meridian.
b=Passage of a large group or spot through the central meridian.
c=New formation of a center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.
d=Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE, in Charge]

By L. T. SAMUELS

An airplane observation station was established at El Paso, Tex., on July 1.

At those stations with a sufficient period of record for the determination of approximate normals, upper-air temperatures during July averaged close to normal. (See table 1 and footnote thereon.) Upper-air relative humidities averaged slightly above normal in most cases.

The resultant winds for the month were, in general, as follows: At 2,000 meters, the directions were generally close to normal, and the velocities mostly above normal. At 5,000 meters, the directions were close to normal at most stations except Albuquerque and Oklahoma City, where a pronounced southerly component prevailed as compared to the normal northerly component. The velocities were mostly above normal over the southern half of the country, and below normal over the northern half, particularly Chicago and Spokane, where the departures exceeded 3 meters per second.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during July 1935*

TEMPERATURE (° C)

Stations	Altitude (meters) m. s. l.																Number of observations
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	
Barksdale, La.[1] (52 m)	24.4		25.8		22.7		19.3		16.5		13.7		10.9		5.2		−1.0		31
Billings, Mont.[2] (1088 m)	18.4						20.8		18.9		15.6		12.6		5.4		−2.6		31
Cheyenne, Wyo.[2] (1,873 m)	15.5								17.8		18.1		14.8		6.8		−1.6		30
El Paso [2] (1,194 m)	24.7						25.5		22.7		19.3		15.5		7.2		−0.5		30
Fargo, N. Dak.[2] (274 m)	19.4		21.8		22.4		20.1		17.3		13.9		10.3		3.1		−4.5		31
Kelly Field (San Antonio), Tex.[1] (206 m)	23.3		24.5		22.5		19.6		16.4		13.3		10.5		4.5		−1.7		31
Lakehurst, N. J.[2] (39 m)	21.1		21.4		18.8		16.0		13.5		11.0		8.5		3.3		−2.0		31
Maxwell Field (Montgomery), Ala.[1] (52 m)	24.4		24.5		22.0		18.5		15.3		12.8		10.0		4.4		−1.4		29
Mitchel Field (Hempstead, L. I.), N. Y.[1] (29 m)	20.7		21.5		19.0		16.0		13.0		10.8		8.2		2.3		−3.4		29
Murfreesboro, Tenn.[2] (174 m)	21.9		23.9		20.7		17.1		14.1		11.5		8.4		2.6		−3.7		31
Norfolk, Va.[2] (10 m)	23.5	−1.2	22.7	−1.0	20.9	−0.7	18.5	−0.4	16.2	+0.4	13.9	+0.8	11.4	+1.0	5.7	+1.1	0.4	+1.5	29
Oklahoma City, Okla.[2] (391 m)	23.5		25.2		25.0		21.5		18.1		14.9		11.5		4.6		−1.3		30
Omaha, Nebr.[2] (300 m)	23.6	+1.2	25.6	+1.6	26.0	+1.0	22.9	+0.7	19.6	+0.5	16.1	+0.6	12.5	+0.7	5.2	+0.8	−1.7	+0.9	31
Pearl Harbor, Territory of Hawaii[3] (6 m)																			
Pensacola, Fla.[2] (24 m)	25.0	−0.9	24.0	−0.3	20.7	−0.9	17.3	−1.2	14.2	−1.2	11.4	−1.0	8.4	−1.0	2.5	−1.0	−2.7	−0.4	31
San Diego, Calif.[2] (10 m)	17.9	−2.6	17.0	−1.2	21.7	−0.4	21.8	−0.4	20.1	−1.1	17.7	−1.4	14.5	−2.3	7.7	−2.0	0.3	−2.4	31
Scott Field (Belleville), Ill.[1] (135 m)	21.5		25.5		22.8		19.9		17.2		14.2		11.2		4.9		−1.0		30
Seattle, Wash.[2] (25 m)	13.4	−2.8	12.9	−0.8	12.6	−0.1	10.7	−0.2	8.8	−0.2	6.7	−0.1	4.7	+0.2	−0.8	+0.3	−6.9	+0.3	30
Selfridge Field (Mount Clemens), Mich.[1] (177 m)	20.2		22.1		19.7		16.4		13.1		10.2		7.4		1.1		−4.8		31
Spokane, Wash.[2] (596 m)	15.1				18.8		17.8		14.4		10.5		6.9		0.3		−7.1		31
Sunnyvale, Calif.[2] (10 m)	16.6	−0.6	15.4	−0.2	18.3	−0.4	18.8	−1.2	16.4	−1.6	13.0	−1.9	9.6	−2.0	2.7	−1.4	−5.0	−1.4	20
Washington, D. C.[2] (13 m)	22.3	−1.7	22.6	+0.3	20.1	−0.2	17.2	−0.4	14.5	−0.3	11.7	−0.2	9.1	0.0	4.2	+0.7	−1.0	+1.4	31
Wright Field (Dayton), Ohio[1] (244 m)	19.8		22.4		21.0		17.7		14.6		11.8		9.4		3.9		−2.1		30

RELATIVE HUMIDITY (PERCENT)

Barksdale, La.	88		63		67		70		65		59		57		51		46		
Billings, Mont.	59						45		41		44		44		42		47		
Cheyenne, Wyo.	66								39		47		46		51		60		
El Paso, Tex.	45						44		44		46		51		65		68		
Fargo, N. Dak.	88		72		61		56		50		47		49		46		43		
Kelly Field (San Antonio), Tex.	91		80		69		67		68		62		55		49		51		
Lakehurst, N. J.	90		74		75		77		71		66		65		60		50		
Maxwell Field (Montgomery), Ala.	87		73		70		77		77		67		65		62		53		
Mitchel Field (Hempstead, L. I.), N. Y.	92		73		71		74		72		64		59		56		53		
Murfreesboro, Tenn.	89		68		72		77		69		61		60		51		46		
Norfolk, Va.	86	+6	83	+10	78	+10	75	+8	70	+6	65	+4	63	+6	64	+9	57	+9	
Oklahoma City, Okla.	82		73		62		63		62		57		56		56		52		
Omaha, Nebr.	82	+5	69	+2	55	+2	52	+1	51	+2	48	−1	48	−2	49	−2	45	−4	
Pensacola, Fla.	89	+3	81	+1	80	+4	80	+6	77	+6	71	+3	70	+4	69	+5	58	+1	
San Diego, Calif.	88	+10	85	+4	52	+1	40	0	34	+2	32	−3	32	−6	32	−11	37	−8	
Scott Field (Belleville), Ill.	93		65		68		65		61		59		55		54		52		
Seattle, Wash.	85	+9	81	+3	73	0	70	+2	66	+3	61	+3	55	+3	53	+4	51	+4	
Selfridge Field (Mount Clemens), Mich.	86		66		66		69		71		63		57		53		42		
Spokane, Wash.	65				51		47		49		53		55		53		52		
Sunnyvale, Calif.	74	0	73	−1	55	+2	43	+7	39	+9	36	+8	34	+8	33	+9	32	+9	
Washington, D. C.	89	+14	70	+2	71	+7	74	+9	70	+5	69	+7	66	+7	57	+5	51	+4	
Wright Field (Dayton), Ohio	91		75		71		72		67		59		53		45		41		

[1] Army. [2] Weather Bureau. [3] Navy.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during July 1935*—Continued

TEMPERATURE (° C.)

[Late reports for May 1935]

Stations	Altitude (meters) m. s. l.																		Number of observations
	Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	
Pearl Harbor, Territory of Hawaii[1] (6 m).	21.8	−3.9	20.2	−1.5	17.1	−0.7	14.3	−0.7	13.6	+0.8	13.1	+1.3	11.3	+1.0	5.9	+0.1	0.3	+0.1	31
RELATIVE HUMIDITY (PERCENT)																			
Pearl Harbor, Territory of Hawaii.	80	+14	79	+6	83	+3	81	+5	59	−8	36	−13	27	−9	21	−3	19	−3	------

TEMPERATURE (° C.)

[Late reports for June 1935]

Pearl Harbor, Territory of Hawaii.	22.9	−2.8	21.1	−1.1	18.3	−0.2	15.5	−0.3	13.8	+0.4	12.5	+0.5	10.7	+0.3	6.4	−0.2	1.7	+0.1	30
RELATIVE HUMIDITY (PERCENT)																			
Pearl Harbor, Territory of Hawaii.	78	+9	78	+3	81	0	79	+1	67	−5	49	−7	37	−4	24	+1	20	+4	------

[1] Navy.

Observations taken about 4 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.

NOTE.—The departures are based on "normals" covering the following number of observations made during the same month in previous years, including the current year: Norfolk, 149; Omaha, 90; Pensacola, 180; San Diego, 166; Seattle, 56; Sunnyvale, 47; Washington, 222; Pearl Harbor (May), 106; Pearl Harbor (June), 110.

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during July 1935*

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m.)		Atlanta, Ga. (309 m.)		Billings, Mont. (1,088 m.)		Boston, Mass. (15 m.)		Cheyenne, Wyo. (1,873 m.)		Chicago, Ill. (192 m.)		Cincinnati, Ohio (153 m.)		Detroit, Mich. (204 m.)		Fargo, N. Dak. (274 m.)		Houston, Tex. (21 m.)		Key West, Fla. (11 m.)		Medford, Oreg. (410 m.)		Murfreesboro, Tenn. (180 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	10	0.9	316	0.2	352	1.7	263	1.5	274	2.3	230	1.0	37	0.3	254	0.9	168	1.4	332	0.4	117	3.1	261	0.9	145	0.5
500	------	------	252	0.4	------	------	299	5.3	------	------	266	2.8	268	2.4	274	2.7	185	3.6	201	3.2	119	5.5	277	1.5	178	2.1
1,000	------	------	286	0.6	------	------	301	4.6	------	------	279	4.5	291	3.8	284	4.1	228	5.4	172	3.0	115	5.2	300	2.2	230	1.4
1,500	------	------	228	0.8	117	3.6	284	5.5	------	------	280	3.3	290	4.0	287	4.6	242	5.9	161	2.5	113	4.2	7	0.9	275	0.8
2,000	166	2.5	251	0.7	132	3.3	281	7.4	245	3.1	281	4.9	188	4.4	289	4.8	271	5.4	146	2.6	116	3.7	30	1.1	262	1.3
2,500	184	3.0	239	0.7	207	2.5	285	8.3	211	3.8	287	4.5	290	4.1	299	4.0	272	6.0	124	2.4	122	2.6	222	1.6	264	1.0
3,000	198	3.2	242	1.4	249	4.8	292	8.8	229	4.2	287	5.1	295	4.5	293	4.8	279	7.7	101	2.4	97	2.5	208	3.4	310	1.3
4,000	214	1.6	319	1.7	247	8.3	292	10.2	260	3.6	273	4.4	304	4.9	301	5.0	285	6.0	76	3.1	84	1.7	220	6.0	241	1.5
5,000	196	1.9	306	2.8	249	10.6	------	------	268	3.1	------	------	------	------	292	6.5	------	------	84	3.1	------	------	233	9.7	------	------

Altitude (m) m. s. l.	Newark, N. J. (14 m.)		Oakland, Calif. (8 m.)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m.)		Pearl Harbor, Territory of Hawaii [1] (68 m.)		Pensacola, Fla.[1] (24 m.)		St. Louis, Mo. (170 m.)		Salt Lake City, (1,294 m.) Utah		San Diego, Calif. (15 m.)		Sault Ste. Marie, Mich. (198 m.)		Seattle, Wash. (14 m.)		Spokane, Wash. (603 m.)		Washington, D. C. (10 m.)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	318	0.6	317	1.2	173	3.4	165	2.2	------	------	16	0.9	254	0.9	162	4.7	328	0.3	173	0.1	148	0.7	111	1.1	289	0.3
500	293	4.2	245	2.2	183	6.6	195	6.2	------	------	76	0.4	246	3.3	------	------	14	0.4	231	1.8	19	1.4	------	------	289	1.7
1,000	278	6.1	322	3.4	198	10.6	221	10.2	------	------	225	0.6	276	3.2	------	------	339	2.2	278	4.5	322	0.3	220	2.1	298	1.3
1,500	277	6.8	288	1.7	202	7.4	236	9.1	------	------	192	1.6	299	4.1	172	8.1	331	3.1	277	5.6	274	1.0	231	3.0	291	2.6
2,000	280	8.0	272	2.1	201	4.0	242	5.5	------	------	184	1.4	321	4.9	180	8.0	318	2.1	288	7.1	264	1.4	234	3.0	281	3.6
2,500	272	8.7	258	2.2	187	2.7	245	4.1	------	------	258	0.9	326	4.6	194	6.2	109	1.2	287	9.2	242	1.8	240	3.1	285	4.7
3,000	283	7.0	248	4.8	147	3.1	258	4.1	------	------	304	1.1	332	4.5	216	6.0	140	3.5	288	11.0	243	3.1	236	4.1	290	4.8
4,000	------	------	------	------	115	3.8	307	4.5	------	------	46	0.7	------	------	220	5.8	142	4.0	290	9.5	242	5.3	247	8.9	294	5.7
5,000	------	------	------	------	156	2.4	------	------	------	------	------	------	------	------	218	5.8	156	0.2	302	10.0	------	------	------	------	323	5.0

[1] Navy stations.

RIVERS AND FLOODS

[River and Flood Division, MONTROSE W. HAYES, in charge]

By RICHMOND T. ZOCH

The most disastrous floods during July were those in New York and northeastern Pennsylvania. Record breaking stages were reached in practically all of the small streams there, causing the loss of 52 lives (40 in New York, and 12 in Pennsylvania), and about $26,000,000 in property, $25,000,000 being in New York State.

The following is an account of the meteorological conditions which caused the flood-producing rains, prepared by Charles L. Mitchell of the Weather Bureau in Washington:

The heavy rains were due, not to any single cause, but to a combination of causes. At 8 p. m. of July 3 a well-defined disturbance was moving eastward over the Hudson Bay region, and an ill-defined, slow-moving disturbance was over the Rocky Mountain region and the Plains States. At the same time a mass of polar air had begun to move southward over northern Canada. During the next 24 hours the northern disturbance had moved rapidly east-southeastward to the lower St. Lawrence Valley, the western disturbance had assumed more definite form and was central over South Dakota, and the polar continental air had overspread the Hudson Bay region. By the morning of the 5th the center of the northeastern disturbance was over the Gulf of St. Lawrence and the Dakota disturbance was over Minnesota and extreme western Ontario, moving northeastward. However, its further advance in that direction was blocked by a wedge of the polar continental air that had by this time pushed southeastward over James Bay and northern Ontario. With the center of the northern high pressure area still west of Hudson Bay, the disturbance was not merely blocked in its northeastward movement, but was carried along by the general drift of the upper air toward the east-southeast until the morning of the 7th, when the center was near Buffalo, N. Y. Meanwhile, the front of the polar continental air mass which had reached northern New England and extreme northern New York the evening of the 5th, pushed southward and southwestward, and at 8 p. m. of the 7th this cold front extended from a short distance south of New Haven, Conn., northwestward to Lake Ontario, through or very close to the area over which excessive rain was then falling and continued to fall through the night. For the second time the disturbance was blocked and it made no further eastward progress; but its center drifted slowly southward during the next 24 hours and merged with another disturbance that moved northeastward from Georgia to the New Jersey coast where it was centered the evening of the 8th. Due to this unusual meteorological situation a mass of warm and very moist tropical maritime air moved north-northwestward over eastern and central New York, while at the same time a mass of polar continental air was moving southeastward over the Lake region and its front had reached eastern Lake Erie by 8 p. m. of the 7th. The inevitable result was that for a period of many hours, by the physical processes of convergence and forced convection, the continuous stream of tropical maritime air was lifted rapidly; and heavy and prolonged rainfall occurred over a considerable area, of which Cortland appeared to be the center. Wherever the tropical maritime air mass was forced to rise over elevated areas the rainfall was naturally even heavier than over other sections where the wind was not upslope.

The following comments of John C. Fisher, Weather Bureau Office, Ithaca, N. Y., are of interest:

Thunderstorms were general over south-central New York during the period July 6–9, inclusive, with the heaviest precipitation recorded on the 7th and 8th. Over an area extending from northern Steuben County eastward to northern Delaware County new records for 24-hour precipitation were established at all stations. The heaviest rainfall occurred over a still more limited area extending from Keuka Lake to central Chenango County, in extent approximately 100 miles from west to east and 15 to 20 miles from north to south, and covering the divide between Finger Lake drainage to the north and Susquehanna and Delaware drainage to the south; here from 9 to over 10 inches fell during the 2-day period July 7–8 inclusive.

The distribution of rainfall was unusually uniform for thunderstorm precipitation, but naturally there was considerable variation in amount. Observations indicate that while a few sections escaped serious damage, in other districts the rainfall was undoubtedly much heavier than recorded by any of the standard gages.

The only automatic rain gage in the area of maximum rainfall is located at Ithaca; so this record, which shows the time of fall of each .01 inch, is of considerable interest. Previous records of severe thunderstorms show greater intensities of rainfall for periods of from 5 minutes to 2 hours; but the former 24-hour maximum amount was 4.70 inches, while 7.90 was recorded between 4 p. m. of July 7 and 4 p. m. of July 8, 1935. If this record is indicative of conditions throughout the area, the rainfalls were not of the type commonly characterized as "cloudbursts"; in other words, while the *amount* of precipitation falling in 24 hours and 48 hours exceeded all previous records, the *rate of fall* was not unusually high at any time.

In this portion of New York State the topography is rough, with many small streams discharging steeply into glacial valleys. The unprecedented rainfall brought many of these streams to flood peaks so sudden and high that people were caught practically unaware, trapped in houses, automobiles, and cottages on the shores of the Finger Lakes. During the early hours of July 8, creeks whose summer flow is usually insignificant discharged water many feet deep through the centers of Urbana, Hammondsport, Watkins Glen, Montour Falls, Myers, Trumansburg, Marathon, Lisle, Willett and other towns and villages. Trees, buildings, and other debris jammed bridges and culverts, streams were diverted, roads washed out, houses demolished, fields deeply gullied or buried under gravel, railroads washed out, and bridges carried away.

There was also great damage through inundation. The run-off to the north submerged thousands of acres of highly productive muck and bottom lands, while the Canisteo River at Hornell and the Chenango at Binghamton flooded residential and business sections, as was also the case at Ithaca, Bath, and many other towns in a lesser degree.

Estimates of total damage vary, and some items can hardly be approximated; however, it is considered that $25,000,000 is conservative. The loss to State highways was approximately $3,000,000, of which $1,750,000 was damage to bridges; damage to town and county roads was very probably greater, with some 540 bridges of a span greater than 5 feet to be replaced. The railroads, excluding loss of business, suffered property loss in excess of $1,250,000. Public utilities had heavy damage, as did the State parks at Watkins Glen, Enfield, and Taughannock Falls. Damage to urban property was in the millions, but no accurate figures are available. Suburban damage, including buildings, livestock, destruction of crops, loss of use of land, soil erosion, etc., was probably greater than any of the above items.

While the loss of 40 lives was directly attributable to the floods, prompt action of the proper authorities provided food and shelter for those driven from their homes, and also prevented any outbreaks of water-borne diseases.

All streams in the Mississippi System passed below flood stage during July. All of the important features of these floods have been mentioned in previous issues of the MONTHLY WEATHER REVIEW.

Table of flood stages in July 1935

[All dates are in July unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE					
	Feet			*Feet*	
Lackawaxen: Hawley, Pa.	6	10	10	6.8	10
Lehigh: Lehighton, Pa.	9	10	10	13.0	10
Schuylkill: Reading, Pa.	7	9	11	15.8	10
Chemung: Corning, N. Y.	16	8	9	20.15	8
Susquehanna:					
Oneonta, N. Y.	12	8	11	16.7	8
Bainbridge, N. Y.	11	8	10	18.5	8
Binghamton, N. Y.	14	9	10	17.7	9
Towanda, Pa.	16	9	10	21.0	9
Wilkes-Barre, Pa.	22	10	11	25.6	10
Tar: Greenville, N. C.	12	16	17	12.1	17
Savannah: Ellenton, S. C.	14	22	27	15.8	26, 27
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Mississippi:					
Keokuk, Iowa	12	6	8	13.0	7
Quincy, Ill.	14	7	8	14.4	7, 8
Hannibal, Mo.	13	1	9	14.4	8
Louisiana, Mo.	12	2	10	12.1	8
Alton, Ill.	21	1	7	22.0	4
Chester, Ill.	27	1	7	27.7	2
Missouri Basin					
Solomon: Niles, Kans.	24	3	3	24.4	3
Smoky Hill:					
Lindsborg, Kans.	21	4	4	23.6	4
Salina, Kans.	20	2	3	21.0	3
		6	6	20.0	6
Enterprise, Kans.	26	4	6	27.2	5
Ohio Basin					
Tuscarawas: Coshocton, Ohio	11	5	5	11.5	5
Little Miami: Kings Mills, Ohio	17	25	25	18.8	25

Table of flood stages in July 1935—Continued

[All dates are in July unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
Arkansas Basin					
Arkansas:	*Feet*			*Feet*	
Fort Lyon, Colo.	5	22	22	5.9	22
Van Buren, Ark.	22	2	2	22.5	2
Red Basin					
Red:					
Grand Ecore, La.	33	May 26	4	35.7	1
Alexandria, La.	32	May 8	11	41.3	June 4
Lower Mississippi Basin					
Mississippi:					
Vicksburg, Miss.	43	June 8	12	44.7	4, 5
Natchez, Miss.	46	June 1	17	49.3	4-7
Angola, La.	45	May 31	19	48.0	4-10
Baton Rouge, La.	35	May 30	20	38.4	5-11
Donaldsonville, La.	28	June 5	19	30.0	6-11
Reserve, La.	22	June 8	17	23.6	9-11
New Orleans, La.	17	1	13	17.4	8, 9
Atchafalaya Basin					
Atchafalaya:					
Simmesport, La.	41	June 4	16	42.5	5-10
Melville, La.	37	May 20	20	39.6	4-11
Atchafalaya, La.	22	Mar. 15	28	24.7	11-15
WEST GULF OF MEXICO DRAINAGE					
Trinity: Liberty, Tex.	25	3	12	25.9	9
Nueces: Cotulla, Tex.	15	29	(*)	18.6	30

* Flood continued into August.

WEATHER OF THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, W. F. McDONALD, in Charge]

NORTH ATLANTIC OCEAN, JULY 1935

By H. C. HUNTER

Atmospheric pressure.—The pressure during July averaged greater than normal over most of the North Atlantic Ocean, notably in the region of the British Isles; in the north central and northwestern parts the pressure was less than normal, especially near Iceland, where Reykjavik averaged 0.25 inch less. In the Gulf of Mexico, and eastward to the Bahamas and Bermuda, the pressure was a little less than normal.

Of trustworthy pressure readings so far reported, the highest is 30.61 inches, on the 4th, on the Japanese steamship *Glasgow Maru*, near 48° N., 8° W.; the lowest is 29.23 inches, on the American steamship *Tuscaloosa City*, at 8 a. m., the 13th, near 52° N., 53° W. Table 1 indicates that lower readings that that of the *Tuscaloosa City* were noted at Julianehaab and Reykjavik.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, July 1935*

Station	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.69	.....	29.94	28	29.22	11
Reykjavik, Iceland	29.59	−0.25	30.14	29	29.02	15
Lerwick, Shetland Islands	29.91	+.11	30.27	14	29.41	28
Valencia, Ireland	30.17	+.19	30.41	25	29.57	19
Lisbon, Portugal	30.06	+.04	30.16	3, 4, 12	29.93	18
Madeira	30.09	+.04	30.19	8	29.96	20
Horta, Azores	30.34	+.07	30.50	25, 26	30.07	31
Belle Isle, Newfoundland	29.86	−.01	30.20	8, 16	29.30	13
Halifax, Nova Scotia	30.04	+.09	30.36	18	29.62	13
Nantucket	30.00	+.02	30.38	18	29.67	31
Hatteras	30.03	+.02	30.36	18	29.69	8
Bermuda	30.17	−.01	30.30	15	30.04	6, 29, 30
Turks Island	30.05	−.02	30.10	13	29.95	16
Key West	30.01	−.02	30.12	29	29.83	7
New Orleans	29.98	−.02	30.15	30	29.75	8

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observations, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—As usual in midsummer, there was little storminess in the extra-tropical regions. Two periods of the month, however, deserve comment:

About the 10th there was a marked fall of pressure near that portion of the 50th parallel of latitude from the Grand Banks to somewhat eastward of mid-ocean; and strong gradients were found near the chief steamship routes, although the actual center of low-pressure was, for several days, near Iceland or southern Greenland. Several steamships reported gales, mainly near the 50th parallel and on the 10th, 11th, or 12th.

On the 28th a considerable fall of pressure occurred over a small area not far to the eastward of Hatteras. The pressure changes on this day presumably were connected with the local downpour noted in waters east of South Carolina, which is described below. A well-marked center of comparatively small size advanced northeastward, increasing in strength, and for the 29th there are 5 gale reports for the waters just southeast of Nova Scotia, 2 of these estimating the force as whole gale (10). This LOW then turned in its course somewhat to northward, and quickly ceased to affect the main vessel lanes.

No tropical storm occurred in Atlantic waters during July. There were, however, 6 different reports of winds of force 6 to 8; all save 1 were encountered in the Caribbean Sea, and 4 of them occurred during the second week of July. The contrast between high pressure of the Azores region and low pressure near the equator was clearly the cause of these winds, which were of the nature of intensified trades.

Fog.—There was much more fog than normal during July. From the 45th meridian to the coasts of Europe, fog was considerably more prevalent than it had been during June. The area from 45° to 50° N. and 30° to 40° W. had fog on 14 days. There was less in the region nearer to the European coasts, where the highest incidence was in the square from 45° to 50° N., 10° to 15° W., which had a count of 10 days.

In the Gulf of St. Lawrence and close to Newfoundland less fog was encountered than during June; but over the Grand Banks and to the southwestward and westward to Cape Cod about as much as during June. The square from 40° to 45° N., 65° to 70° W., had 26 days of fog—every day from the 6th to 26th inclusive furnished at least one report. Southwest of Nantucket, fog was distinctly less common than it had been during June, and none has been reported anywhere south of the 35th parallel.

Downpour.—From the American steamer *Mariana*, Capt. C. Zeuthen, an interesting report about torrential rain encountered on a voyage from Philadelphia to Tampa has been received from the observer, Second Officer R. C. Spaulding:

> July 28, 1935, at 1:30 to 2:00 a. m., local mean time, in latitude 32°10′ N., longitude 79°20′ W., encountered a torrential downpour of rain, so heavy it reduced visibility to nothing. It fell straight down and spattered to a height of 3 or 4 feet off the deck. It was actually difficult to breathe standing out in it. The whistle when sounded made a gurgling sound, as if under water. The decks were filled to the "gunnels", water streaming everywhere. Lightning was observed, though barely visible through the murk; continuous loud thunder was heard. There was very little wind, mostly westerly. It was, no doubt, a "cloudburst."

NORTH PACIFIC OCEAN, JULY 1935

By WILLIS E. HURD

Atmospheric pressure.—Almost normal barometric conditions prevailed over the North Pacific Ocean during July 1935. Most of the eastern part of the ocean was dominated by the usual high-pressure area, within which few cyclonic disturbances occurred. The Aleutian LOW on the average lay over the northwestern part of the ocean and the Bering Sea. Pressure was low throughout Asiatic waters, with the center on the average off the southeast coast of China (mean at Hong Kong, 29.59 inches). The greatest departure from the monthly normal, as shown in table 1, was —0.06 inches, at Guam.

OCEAN GALES AND STORMS, JULY 1935

Vessel	Voyage		Position at time of lowest barometer		Gale began July—	Time of lowest barometer July—	Gale ended July—	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
	From—	To—	Latitude	Longitude									
NORTH ATLANTIC OCEAN			° ′	° ′				*Inches*					
Waukegan, Am. S. S.	Havre	New York	44 57 N.	41 12 W.	6	10p, 6	7	29.87	SW	SW, 8	W	SW, 8	SW-W.
Betterton, Am. S. S.	New York	Houston	35 38 N.	75 08 W.	8	6p, 8	9	29.68	SW	SW, 7	SW	SW, 8	SSW-SW.
Sanyo Maru, Jap. M. S.	Puerto Colombia.	New York	12 10 N.	75 20 W.	9	4a, 9	10	[1] 29.85	NNE	NNE, 7	ENE	ENE, 8	
New York, Ger. S. S.	Cherbourg	do	42 28 N.	51 40 W.	10	4p, 10	10	29.62	SW	W, 7	SW	SW, 9	SW-W-WNW.
Collamer, Am. S. S.	Havre	do	48 36 N.	29 04 W.	10	11p, 10	11	29.55	SW	SW, 8	SW	SW, 8	
Montreal City, Br. S. S.	Fowey	Philadelphia	50 40 N.	30 45 W.	11	5a, 11	11	29.48	SSW	SSW, 8	SW	SSW, 8	SSW-NW.
Laganbank, Br. M. S.	Algiers	Boston	38 36 N.	55 42 W.	10	8a, 11	11	29.98	SW	SW, 9	W	SW, 9	SW-WSW.
Mopan, Br. S. S.	Jamaica	Avonmouth	49 12 N.	23 05 W.	11	11a, 12	11	29.47	SSW	SSW, 6	SSW	SSW, 8	SW-SSW-WNW.
S. B. Hunt, Am. S. S.	Cartagena	Aruba	[1] 11 15 N.	75 08 W.	14	4p, 14	14	29.70	NE	NE, 7	NE	NE, 7	None.
Winona County, Am. S. S.	Dundee	Boston	[2] 57 59 N.	20 42 W.	14	10p, 14	14	29.72	SW	SW, 5	SW	SSW, 9	SW-W.
Fred W. Weller, Am. S. S.	Cartagena	Aruba	11 42 N.	74 00 W.	19	4a, 20	19	29.85	ENE	ENE, 4	ENE	ENE, 6	ENE-E.
New Brunswick, Br. S. S.	Dakar	Boston	38 26 N.	64 26 W.	26	9p, 26	27	29.95	SW	SW, 10	N	SW, 10	SW-NW-N.
Yselhaven, Du. S. S.	Antwerp	Norfolk	[2] 41 33 N.	61 49 W.	28	4p, 29	29	29.34	SE	WSW, 10	WSW	SE, 10	SE-WSW-W.
Maasdam, Du. S. S.	Rotterdam	New York	42 04 N.	61 17 W.	29	6p, 29	29	[1] 29.19	SSE	SSE, 9	SW	SSW, 10	SSE-SW.
Silvercypress, Br. M. S.	Gibraltar	Halifax	42 56 N.	59 50 W.	29	10p, 29	30	29.61	S	SSW, 9	SW	SSW, 9	S-SSW.
NORTH PACIFIC OCEAN													
City of San Diego, Am. M. S.	Fishing grounds	Manzanillo	18 40 N.	104 20 W.	1	5a, 1	1	29.82	SE	N, 2	SE	SSE, 8	N-E-SE.
Grays Harbor, Am. S. S.	Seattle	Yokohama	51 48 N.	170 45 W.	1	8a, 2	2	29.32	S	S, 8	S	SSE, 8	SSE-SSW.
Silverash, Br. M. S.	San Francisco	Manila	20 50 N.	142 30 E.	2	3a, 3	3	29.79	SSE	S, 8	SSE	S, 9	SSE-SSW.
Oregon, Am. S. S.	Manila	Los Angeles	44 14 N.	154 -- W.	10	10p, 11	11	29.70	N	NW, 5	N	N, 8	N-NW.
Silverbelle, Br. M. S.	do	do	[2] 39 14 N.	145 07 W.	11	4p, 11	12	29.82	SSW	S, 7	S	SSW, 9	S-SSW.
Oregon, Am. S. S.	do	do	36 06 N.	124 35 W.	17	6p, 18	18	29.91	NNE	N, 8	N	N, 9	None.
General Lee, Am. S. S.	Portland, Oreg.	Yokohama	51 40 N.	171 15 W.	22	4p, 22	22	29.56	SSW	SW, 8	WSW	SW, 9	SSW-SW.

[1] Barometer uncorrected.

[2] Position approximate.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean, July 1935, at selected stations.*

Station	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Point Barrow	29.88	−0.04	30.32	5	29.42	26
Dutch Harbor	29.95	+.01	30.56	31	29.44	17
St. Paul	29.86	+.02	30.30	31	29.50	2
Kodiak	29.98	+.04	30.20	25	29.50	20
Juneau	30.07	+.02	30.27	17	29.81	1
Tatoosh Island	30.07	+.02	30.27	28	29.85	22
San Francisco	29.94	−.01	30.09	8	29.72	1
Mazatlan	29.87	+.01	29.98	30	29.80	28
Honolulu	30.00	−.02	30.06	21	29.92	26
Midway Island	30.11	.00	30.22	9	30.00	7
Guam	29.78	−.06	29.88	15	29.52	24
Manila	29.71	−.03	29.82	1, 15	29.58	21
Hong Kong	29.59		29.76	2, 11	29.23	30
Naha	29.71	−.01	29.81	1	29.40	27
Chichishima	29.89	+.04	30.00	14	29.72	7
Nemuro [1]			30.00	10	29.58	29

[1] Based on data for 19 days only.

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu, which are based on 2 observations. Departure are computed from best available normals related to time of observation.

Cyclones and gales of the temperate zone.—The deepest extra-tropical cyclone of July occurred over extreme northwestern waters early in the month. At Attu Island, in the extreme western Aleutians, barometer readings as low as 29.08 inches, on the 1st, and 29.06, on the 2d, were recorded. The cyclone affected most of the Bering Sea and adjacent Pacific from the 1st to 3d, thereafter gradually retreating northwestward and filling in. The only gales of record in connection with the disturbance were of force 8 from south-southeast near 52° N., 171° W., on the night of the 1st–2d. A gale in the same vicinity on the 22d attained force 9.

From the 10th to 12th a depression of moderate energy lay about midway between the Hawaiian Islands and Alaska, and caused local gales of force 8 in the neighborhood of 44° N., 154–155° W., on the 10th and 11th, and of force 9, near 39° N., 145° W., early on the 12th.

The weather off the central California coast was disturbed by moderate to fresh local northerly gales on the 1st, and by moderate to strong local northerly gales on the 17th and 18th.

Tropical disturbances.—During July 1 disturbed conditions prevailed off the Mexican coast between Acapulco and Manzanillo. The American motorship *City of San Diego* received a radio report that a cyclone was moving up the coast, and made port at Manzanillo, arriving at noon in a southeasterly gale of force 8. The American steamship *Missourian* reported a wind of force 7 in the vicinity earlier in the day. No further development of the disturbance has been indicated.

In the Far East a similarly disturbed and apparently undeveloped condition prevailed during a part of the 2d and 3d in the neighborhood of 21° N., 142–143° E., where the British motorship *Silverash* encountered fresh to strong southerly gales, with slightly depressed barometer.

In connection with the subjoined Manila report, furnished by the Rev. Bernard F. Doucette of the Manila Observatory, the following additional items are presented relative to the two typhoons described:

During the passage of the typhoon of the 15th–23d, a pressure reading of 29.16 inches was reported at Ishigakijima Island on the 20th, and a northwest gale of force 8 occurred in the Luzon Strait on the 19th.

While the typhoon of July 22–31 lay east of Taiwan (Formosa) on the 28th, a report from Ishigakijima Island gave a barometer of 28.98 and a northwest gale of force 8. About 100 vessels took refuge in Kelung harbor on the 29th. The storm passed over Taiwan late on that date, temporarily isolating the island on account of extensive damage to communications lines.

Fog.—Fog was the most important meteorological element affecting travel along the northern routes. To the northward of the 40th parallel, it was reported on from 3 to 15 or more days within the several 5° squares, with a general increase westward from the Washington and Oregon coasts to the region of maximum formation between the 180th meridian and 150° E. A number of ships made specific comments upon the extent to which it was observed.

The British motorship *Silverguava* reported 86 hours of continuous fog, from 4 p. m., of the 4th, in 43°43′ N., 140°00′ W., until 6 a. m. of the 8th, in 46°48′ N., 168°10′ W.

The American motorship *Ward* reported mostly thick fog, with only short periods of clearing, from 5 a. m., July 17, in 40°23′ N., 159°16′ E., until 10 p. m., July 23, in 44°13′ N., 150°00′ W.

The American steamship *President Jefferson* had 88 hours of practically continuous dense fog banks from the 180th meridian westward, July 13 to 16.

There were 11 days with fog along the California coast, and 5 days with fog along the coast of Lower California.

The New York Maritime Register reported the sinking of the Japanese steamship *Midori Maru*, with the loss of 104 lives, due to a collision with another steamer in fog southwest of Kobe on July 3.

TYPHOONS AND DEPRESSIONS OVER THE FAR EAST, JULY 1935

By BERNARD F. DOUCETTE, S. J.

[Weather Bureau, Manila, P. I.]

Two typhoons and two depressions form the total of the disturbances which affected the weather of the lower latitudes in the Far East during July 1935. Of these, the typhoon of July 22 to 31 was the most important. Details of each of these storms follow.

Depression, July 12 to 16.—Forming about 200 miles ENE. of San Bernardino Strait, this depression moved WNW., gradually inclining to the NW. and crossing northern Luzon. Changing to a westerly course as it entered the China Sea, it continued along this course to Indo China. This depression was of little importance. The positions, day by day, of the depression are given below:

	Latitude N. °	′	*Longitude E.* °	′
July 12, 2 p. m.	14	40	127	40
July 13, 6 a. m.	15	30	123	30
July 14, 6 a. m.	18		116	
July 15, 6 a. m.	19		109	30

Typhoon, July 15 to 23.—Appearing between Yap and Palau, a depression moved NW. to a position about 150 miles east of central Luzon, where it intensified as it changed to a northern course. When about 120 miles east of Basco, Batanes Islands, it shifted for a short time to the NE., then N. again, to a position close to the Sakishima Group. There, it inclined to the NW. and proceeded to the China coast, filling up within 24 hours

after entering the Continent. The approximate positions, day by day, are given as follows:

	Latitude N.		Longitude E.	
	°	′	°	′
July 15, 6 a. m.	8	20	135	40
July 16, 6 a. m.	10	30	130	50
July 17, 6 a. m.	14	20	126	
July 18, 6 a. m.	19		123	50
July 19, 6 a. m.	20	40	125	
July 20, 6 a. m.	21	50	125	
July 21, 6 a. m.	23	50	125	
July 22, 6 a. m.	25	50	123	30
July 23, 6 a. m.	27	30	119	

Typhoon, July 22 to 31.—After an irregular course over the Western Caroline Islands and the Ladrone Islands, this typhoon moved quite rapidly along a northwest course across the ocean. It changed to the west when approaching the Nansei (Loochoos) Islands, crossed Formosa and entered the continent. The daily positions are listed below:

	Latitude N.		Longitude E.	
	°	′	°	′
July 22, 6 a. m.	10		145	
July 23, 6 a. m.	10	40	142	
July 24, 6 a. m.	14	30	142	
July 25, 6 a. m.	17		143	
July 26, 6 a. m.	18		139	
July 27, 6 a. m.	20	40	133	
July 28, 6 a. m.	23	20	129	
July 29, 6 a. m.	23	30	124	
July 30, 6 a. m.	24		119	30
July 31, 6 a. m.	24		114	

There was considerable destruction over Formosa as this typhoon crossed the island, but details are not yet available. Over the Philippines, rains caused great damage along the western coast of Luzon and over the provinces between Manila and Baguio. Reports from the U. S. S. *Gold Star*, the steamship *Steel Seafarer*, the steamship *Penrith Castle*, showed that the southwest winds of this typhoon were strong and prevailed over a very wide area. Without a doubt, this was the most important typhoon of the month.

A few remarks are in order concerning the movement of this typhoon on July 24. On the two preceeding days, it had recurved from a west northwest course to a northeast course and was, on July 24, moving quite fast about 200 miles northwest of Guam. Late in the afternoon, however, it slowed down and was almost stationary, about 200 miles north of the island. During the night, it began to move northwest and the morning of the 25th found it started on its journey to Formosa. These details concerning the movement at these times have been obtained from the hourly observations sent to the observatory through the kindness of the officials of the Commercial Pacific Cable Co., and from the observations of the steamship *Nemea*. It seems that a high-pressure area developed northeast of Guam, but, as Guam is on the border of the region of observation, this explanation will have to be verified when weather maps of the whole north Pacific arrive.

Depression, July 25 and 26.—This depression, of little importance, formed east of Luzon, then moved north-northwest to combine with the typhoon just described above. The approximate positions during these 2 days are given below:

	Latitude N.		Longitude E.	
	°	′	°	′
July 25, 6 a. m.	16	10	129	
July 26, 6 a. m.	17	30	128	40

CLIMATOLOGICAL TABLES

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, July 1935

[For description of tables and charts, see REVIEW, January, p. 37]

Section	Temperature: Section average	Temperature: Departure from the normal	Temperature: Monthly extremes: Station	Highest	Date	Station	Lowest	Date	Precipitation: Section average	Departure from the normal	Greatest monthly: Station	Amount	Least monthly: Station	Amount
	° F.	° F.		° F.			° F.		*In.*	*In.*		*In.*		*In.*
Alabama	81.3	+1.0	Tuscaloosa	103	31	2 stations	60	[1] 10	4.74	−0.68	Clayton	15.48	Florence	0.77
Arizona	80.6	−1.2	Quartzsite	118	16	Fort Valley	29	4	1.29	−.81	Jerome	4.87	San Simon	.00
Arkansas	82.2	+1.8	Hot Springs	107	31	Dutton	53	15	2.32	−1.46	Wilson	5.95	Marianna	.07
California	71.0	−2.6	Cow Creek	123	13	Twin Lakes	22	[1] 8	.07	.00	Bridgeport	1.47	102 stations	.00
Colorado	70.0	+3.0	2 stations	106	[1] 6	3 stations	25	[1] 1	1.52	−.70	Dillon	5.09	La Veta Pass	.04
Florida	80.7	−.6	De Funiak Springs	101	8	Davie	58	31	9.11	+1.88	Madison	20.68	Chapman Field Garden.	2.81
Georgia	80.0	−.1	4 stations	100	5	Blairsville	51	16	6.87	+1.15	Lumber City	16.91	La Fayette	1.46
Idaho	68.5	+.5	Lewiston	116	14	Obsidian	22	1	.31	−.30	Mullan	1.95	13 stations	.00
Illinois	79.0	+2.7	2 stations	104	31	2 stations	51	16	3.33	+.04	La Harpe	7.78	Jacksonville	.81
Indiana	78.9	+2.4	do	102	31	Wheatfield	48	16	3.57	+.22	Greenfield	8.70	Rochester	.94
Iowa	79.4	+5.0	Sac City	107	28	Maquoketa (near)	51	14	3.35	−.38	Boone	8.86	Lenox	.70
Kansas	84.3	+5.5	Phillipsburg	113	10	Burr Oak	53	14	.68	−2.56	Lindsborg	4.18	3 stations	.00
Kentucky	78.8	+1.5	Murray	103	31	3 stations	56	[1] 14	5.16	+1.02	Pine Mountain	11.21	Paducah	.80
Louisiana	82.7	+.9	Leesville	104	8	Pollock	57	15	5.24	−.92	Port Eads	13.33	Shreveport	1.02
Maryland-Delaware	76.9	+1.7	2 stations	101	20	Grantsville, Md	42	30	4.24	.00	Aberdeen, Md	8.85	Keedysville, Md	1.58
Michigan	73.0	+4.3	Centerville	101	19	Dukes	33	16	2.57	−.28	Ironwood	8.55	Croswell	.05
Minnesota	75.0	+5.2	New Ulm	108	27	Grand Marais	42	3	3.82	+.46	Leech Lake Dam	9.33	Faribault	.86
Mississippi	82.2	+1.1	Duck Hill	105	31	Batesville	59	15	3.20	−1.83	Pearlington	11.77	Scott	.25
Missouri	80.8	+3.0	4 stations	104	[1] 26	2 stations	53	[1] 14	3.12	−.65	Greenville	8.82	Nevada	T
Montana	69.1	+2.4	2 stations	111	28	do	25	[1] 1	1.63	+.15	Poplar	6.87	Lima	.03
Nebraska	81.0	+6.3	Newport	112	27	Merriman	44	16	1.34	−2.00	York	4.50	3 stations	T
Nevada	72.3	.0	Logandale	116	13	Sheldon	28	2	.18	−.18	Searchlight	1.38	9 stations	.00
New England	71.2	+2.1	Turner's Falls, Mass.	101	6	Somerset, Vt	35	[1] 2	3.76	+.04	May's Mills, Vt	8.78	Woodland, Maine	.88
New Jersey	76.0	+2.3	Charlotteburg	101	12	Runyon	40	3	4.66	−.13	Belvidere	10.94	Atlantic City	.70
New Mexico	72.8	+.5	Nara Visa (near)	109	12	Therma (near)	19	5	1.34	−1.22	Mimbres	4.29	Bell Ranch	T
New York	72.7	+3.0	Jamestown	99	6	Indian Lake	32	2	6.37	+2.42	Mount McGregor	19.37	Lewiston	.89
North Carolina	76.8	−.1	2 stations	102	1	Banners Elk	48	30	7.42	+1.60	Wilmington	15.97	Murphy	1.87
North Dakota	73.8	+5.4	Fort Yates	110	26	3 stations	45	[1] 28	4.62	+2.20	Dogden Butte	8.89	Hettinger	1.49
Ohio	76.7	+3.1	Montpelier	106	19	Millport	49	[1] 17	4.93	+1.13	Bangorville	11.59	Catawba Island	1.10
Oklahoma	83.7	+2.1	Okeene	112	11	Boise City	57	15	.94	−2.05	Wichita National Forest.	4.64	Pryor	.00
Oregon	65.5	−.9	Arlington	113	14	Crater Lake	18	8	.56	+.15	Kinzua	2.34	Danner	.00
Pennsylvania	75.0	+3.0	Wellsboro	104	5	Somerset	42	30	5.63	+1.34	Pottsville	13.50	McKeesport	1.47
South Carolina	79.4	−.4	Darlington	105	1	Long Creek	59	1	7.34	+1.54	Charleston	17.78	Kershaw	1.41
South Dakota	79.5	+6.7	Pukwana	113	27	Camp Crook	41	16	2.02	−.58	Harveys Ranch	7.42	Hopewell	.06
Tennessee	79.4	+1.8	2 stations	103	31	2 stations	52	15	3.73	−.68	Franklin	7.87	Loretto	.76
Texas	83.1	.0	Clarendon	111	11	do	52	[1] 16	2.31	−.29	LaPryor	9.65	Trinidad	.00
Utah	72.7	+1.0	St. George	112	13	3 stations	32	[1] 3	.43	−.45	Black's Fork (near)	3.03	11 stations	.00
Virginia	76.2	+.8	Lincoln	101	11	Burkes Garden	48	31	5.04	+.55	Holland	13.75	Manassas	.91
Washington	65.6	−.9	Wahluke (near)	115	14	Paradise Inn	29	8	.84	+.19	Mountain Lakes	2.89	Guler	.01
West Virginia	75.6	+2.5	Martinsburg	101	12	Reedsville	46	30	4.61	+.04	Dam No. 25 O. R.	10.24	Morgantown	1.15
Wisconsin	74.5	+4.5	La Crosse	100	18	Long Lake	41	15	4.24	+.64	Stanley	11.02	Fond Du Lac	.77
Wyoming	68.7	+3.2	4 stations	106	[1] 16	Lake Yellowstone	22	11	.73	−.57	Sundance	3.26	2 stations	.00
Alaska (June)	52.2	+.1	Holy Cross	93	23	Barrow	16	13	3.52	−.20	Ketchikan	8.92	do	T
Hawaii	75.0	+.8	Mahukona	93	13	Kanalohuluhulu	47	16	5.04	−.61	Puhonua	28.70	4 stations	.00
Puerto Rico	78.4	.0	San German	97	5	Guineo Reservoir	54	4	5.01	−1.74	Coloso	13.00	Mona Island	.00

[1] Other dates also.

TABLE I.—*Climatological data for Weather Bureau stations, July 1935*

[Compiled by Annie E. Small, by official authority, U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Thermometer above ground	Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Days with 0.01, or more	Wind: Total movement	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	° F.	° F.	°F.		°F.	° F.		°F.	° F.	° F.	° F.	%	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In*
New England							70.8	+1.9										81	3.52	0.0										6.0		
Eastport	76	67	85	29.90	29.98	+0.05	61.7	+1.3	85	13	71	49	7	52	33	59	58	90	2.38	−0.7	12	6,205	sw.	24	e.	6	5	11	15	6.9	0.0	0.0
Greenville, Maine	1,070	6	40	28.84	29.98		67.7		86	12	79	42	2	56	35				2.87		12	3,135	se	16			12	10	9		.0	.0
Portland, Maine	103	82	117	29.86	29.98	+.03	70.8	+2.7	95	5	78	53	7	63	25	65	62	78	2.72	−.5	10	6,146	s.	21	sw.	28	17	5	9	4.4	.0	.0
Concord	289	60					71.6	+3.1	93	5	83	47	2	60	34				3.04	−.5	8		ne.				14	8	9		.0	.0
Burlington	403	11	48	29.54	29.96	+.02	71.2	+.9	90	5	81	47	2	62	30				4.01	+.5	18	6,305	s.	27	se.	15	6	16	9	5.5	.0	.0
Northfield	876	12	60	29.05	29.98	+.04	68.8	+2.9	90	5	81	39	2	56	39	64	62	79	3.49	−.1	16	4,850	s.	21	s.	15	4	18	9	6.4	.0	.0
Boston	124	336	360	29.85	29.98	+.02	72.6	+.9	92	12	80	58	4	65	23	66	62	74	1.10	−2.4	10	9,399	w.	45	nw.	19	9	9	13	6.0	.0	.0
Nantucket	12	14	90	29.99	30.00	+.02	68.4	+.6	80	13	75	55	28	62	18	65	64	89	5.73	+2.9	7	10,068	sw.	40	s.	15	7	11	13	6.4	.0	.0
Block Island	26	11	46	29.97	30.00	+.03	70.0	+1.6	83	11	76	57	2	65	16	67	66	91	3.51	+.4	10	9,297	sw.	29	e.	9	6	13	12	6.3	.0	.0
Providence	160	215	251	29.83	30.00	+.03	74.2	+.8	94	19	83	56	2	66	25	67	64	74	2.72	−.6	11	6,709	sw.	37	nw.	19	12	10	9	5.3	.0	.0
Hartford	159	70	104	29.82	29.98	+.01	74.8	+3.2	94	12	84	56	3	66	25				5.99	+1.6	11	5,331	s.				6	12	13	6.2	.0	.0
New Haven	106	74	153	29.89	30.00	+.03	75.2	+3.4	95	12	83	57	3	67	26	69	66	76	4.03	−.3	10	6,208	s.	32	n.	19	6	12	13	6.3	.0	.0

TABLE 1.—*Climatological data for Weather Bureau stations, July 1935*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	*° F.*	*° F.*	*° F.*		*° F.*	*° F.*		*° F.*	*° F.*	*° F.*	*° F.*	*%*	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
Middle Atlantic States							76.6	+1.6										75	4.86	+0.5										6.0		
Albany	972	97	112	29.87	29.97	+0.01	75.6	+3.0	96	12	85	54	2	66	29	68	64	72	4.96	+1.5	12	5,135	s.	22	se.	7	8	12	11	5.7	0.0	0.0
Binghamton	871	60	68	29.09	30.00	+.03	73.6	+3.6	93	19	84	50	2	63	32	----	----	----	3.89	+.2	15	3,669	e.	32	ne.	19	6	10	15	6.9	.0	.0
New York	314	415	454	29.66	29.99	+.01	76.2	+2.4	91	12	83	63	3	69	23	69	66	76	3.55	−.7	13	8,981	sw.	46	n.	19	4	17	10	6.1	.0	.0
Harrisburg	374	94	104	29.59	29.98	.00	77.4	+2.6	95	20	86	61	17	68	27	69	65	70	3.46	−.4	12	4,628	s.	21	sw.	21	8	16	7	5.4	.0	.0
Philadelphia	114	168	367	29.89	30.01	+.03	78.2	+2.0	95	20	86	63	4	70	24	70	67	73	5.07	+.9	12	8,273	sw.	40	n.	20	7	10	14	6.1	.0	.0
Reading	323	283	306	29.65	29.99	----	76.7	+1.2	95	12	85	60	3	68	26	69	65	71	6.70	+2.4	16	6,549	s.	53	ne.	20	6	16	9	5.9	.0	.0
Scranton	805	72	104	29.15	30.00	+.02	74.8	+3.1	94	6	85	56	30	65	28	67	63	69	7.91	+3.9	9	4,145	sw.	31	se.	6	8	19	4	5.5	.0	.0
Atlantic City	52	37	172	29.95	30.00	+.02	75.2	+3.1	90	24	81	62	28	70	21	70	68	81	.70	−3.2	6	10,139	s.	36	ne.	19	2	17	12	6.7	.0	.0
Sandy Hook	22	10	57	29.97	29.99	----	75.6	----	93	12	82	63	3	70	22	70	68	80	3.33	−1.8	12	8,031	sw.	37	s.	22	10	12	9	4.7	.0	.0
Trenton	190	88	106	29.79	29.99	----	77.0	+2.5	95	12	86	56	3	68	25	70	67	75	4.07	+.1	12	6,140	s.	30	ne.	20	4	13	14	6.5	.0	.0
Baltimore	123	100	215	29.87	29.99	−.02	77.2	.0	95	12	88	65	28	71	22	71	67	69	4.55	−.1	10	7,117	sw.	38	sw.	21	7	18	6	5.3	.0	.0
Washington	112	62	85	29.88	29.99	−.01	79.4	+2.6	98	20	88	61	28	70	24	71	68	71	2.25	−2.5	12	4,479	s.	21	nw.	23	6	18	7	5.4	.0	.0
Cape Henry	18	8	54	29.99	30.01	----	77.5	.0	95	24	84	64	28	71	23	72	70	82	4.97	−.4	13	7,182	sw.	28	sw.	13	7	15	9	6.1	.0	.0
Lynchburg	686	5	----	29.30	30.03	+.02	78.3	+.8	94	20	89	61	4	67	28	----	----	----	6.76	+2.6	19	----	sw.	----	----	----	0	28	3	----	.0	.0
Norfolk	91	80	125	29.93	30.02	+.02	78.2	−.5	93	21	85	65	28	71	23	72	69	80	7.80	+2.0	15	6,587	sw.	22	sw.	9	5	7	19	7.3	.0	.0
Richmond	144	11	52	29.87	30.02	+.01	77.6	−.9	92	20	86	60	28	69	23	71	69	80	5.64	+.9	10	5,016	sw.	26	nw.	24	6	11	14	6.2	.0	.0
Wytheville	2,304	49	55	----	30.00	−.01	72.6	.0	87	11	83	55	31	62	28	----	----	82	7.04	+3.0	15	3,690	w.	21	sw.	24	7	14	10	----	.0	.0
South Atlantic States							78.9	−0.2										82	9.41	+3.6										6.9		
Asheville	2,253	89	104	27.75	30.03	+.01	74.4	+2.7	90	1	84	59	16	64	28	67	65	81	6.22	+1.9	17	4,655	s.	22	e.	2	2	19	10	6.6	.0	.0
Charlotte	799	63	86	29.21	30.02	.00	79.4	+1.0	97	1	88	67	28	70	26	71	69	78	8.27	+3.2	16	4,667	sw.	25	sw.	9	2	13	16	7.1	.0	.0
Greensboro	886	6	56	29.10	30.04	----	77.6	----	97	1	87	60	28	68	30	70	69	83	4.30	----	12	5,091	sw.	24	sw.	10	2	18	11	6.7	.0	.0
Hatteras	11	5	50	----	30.03	+.02	77.1	−1.1	85	20	82	66	31	72	17	----	----	90	11.68	+6.2	12	9,256	sw.	36	sw.	15	11	10	10	----	.0	.0
Raleigh	376	103	146	29.62	30.01	−.01	78.2	−.6	94	1	87	63	3	70	24	72	70	80	5.11	−.3	14	5,419	sw.	30	se.	17	4	17	10	6.3	.0	.0
Wilmington	72	73	107	29.96	30.03	+.02	77.8	−1.3	92	1	84	65	28	72	21	73	72	84	15.97	+8.8	15	6,727	sw.	30	s.	15	6	10	15	6.7	.0	.0
Charleston	48	11	92	29.99	30.04	+.01	79.3	−2.1	91	5	85	66	8	74	23	75	73	83	17.78	+10.9	16	6,917	sw.	35	nw.	8	3	8	20	7.8	.0	.0
Columbia, S.C	347	67	73	29.66	30.03	+.01	80.4	−.5	96	1	89	66	16	72	25	72	70	79	7.89	+2.5	14	4,555	s.	27	n.	16	3	14	14	6.6	.0	.0
Greenville, S. C	1,039	139	----	----	----	----	78.4	+1.5	94	31	87	66	20	70	24	----	----	----	6.83	+1.5	15	----	w.	----	----	----	9	8	14	----	.0	.0
Augusta	182	62	77	29.82	30.01	−.01	81.0	−.3	95	30	90	69	9	72	25	73	71	79	5.85	+.5	13	4,078	s.	27	se.	9	3	14	14	7.2	.0	.0
Savannah	65	73	152	29.96	30.03	.00	81.1	−.4	97	30	89	70	7	74	22	74	73	83	8.08	+1.4	19	7,036	sw.	27	se.	18	3	14	14	7.0	.0	.0
Jacksonville	43	86	110	29.99	30.04	+.01	80.8	−1.3	94	5	88	69	7	73	23	74	72	83	9.87	+3.2	22	5,462	s.	24	sw.	12	3	14	14	6.9	.0	.0
Florida Peninsula							81.9	0.0										78	8.05	+2.5										6.3		
Key West	22	10	64	29.99	30.01	−.02	82.8	−.7	91	15	88	71	4	78	15	76	74	76	10.08	+6.8	13	6,758	e.	25	se.	25	5	17	9	5.8	.0	.0
Miami	25	124	168	30.01	30.04	.00	81.6	+.6	89	31	86	72	8	77	16	76	73	75	4.05	−1.4	18	7,097	se.	36	sw.	8	3	13	15	7.0	.0	.0
Tampa	35	88	197	30.00	30.03	−.01	81.2	.0	93	5	88	71	15	74	20	74	73	83	10.02	+2.1	19	7,128	e.	32	se.	22	4	19	8	6.1	.0	.0
Titusville	43	5	36	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
East Gulf States							81.4	+0.8										78	5.84	+0.1										6.0		
Atlanta	976	6	53	29.00	30.00	−.02	79.7	+1.6	96	11	90	66	16	70	27	72	70	79	4.00	−.6	14	4,833	e.	33	s.	6	3	14	14	7.0	.0	.0
Macon	370	79	87	29.62	30.01	−.01	80.8	−.4	98	8	90	69	14	72	25	73	71	78	6.77	+2.0	13	4,500	s.	24	n.	29	3	13	15	6.5	.0	.0
Thomasville	273	49	58	29.74	30.03	.00	79.8	−2.0	94	8	89	66	8	71	26	75	74	88	12.13	+5.4	23	----	sw.	----	----	----	0	13	18	----	.0	.0
Apalachicola	35	11	51	29.97	30.01	----	81.2	----	93	30	87	72	1	76	17	76	----	----	9.44	+1.7	18	----	sw.	----	----	----	0	19	12	----	.0	.0
Pensacola	56	149	185	29.94	70.00	−.01	80.6	−.4	95	7	86	69	17	75	22	75	73	80	5.28	−1.5	17	7,732	sw.	38	s.	31	6	18	7	5.5	.0	.0
Anniston	741	9	----	----	----	----	80.1	+2.2	96	31	90	63	16	70	31	----	----	----	5.46	+.3	10	----	----	----	----	----	12	14	4	----	.0	.0
Birmingham	700	11	48	29.25	30.00	−.01	82.0	+1.8	99	31	92	66	15	71	28	72	69	74	1.77	−3.4	8	4,365	se.	18	e.	27	7	17	7	5.3	.0	.0
Mobile	57	125	161	29.92	29.98	−.03	82.0	+.6	97	8	90	69	1	74	23	75	73	80	6.16	−.7	16	5,848	s.	33	e.	17	3	12	16	6.8	.0	.0
Montgomery	218	92	105	29.76	30.00	−.02	82.1	+.4	97	8	91	69	1	73	23	74	71	78	5.63	+.8	16	4,577	e.	25	ne.	13	6	11	14	6.5	.0	.0
Meridian	375	67	92	29.60	29.98	−.04	82.0	+1.6	98	31	92	66	16	72	29	73	70	72	3.06	−1.8	11	3,716	e.	21	ne.	6	9	20	2	4.7	.0	.0
Vicksburg	247	65	73	29.74	30.00	.00	83.0	+1.7	97	17	92	69	2	74	22	74	71	74	1.90	−2.6	7	4,354	se.	28	e.	26	8	15	8	5.3	.0	.0
New Orleans	53	76	84	29.93	29.98	−.02	83.6	+1.2	98	9	90	70	1	77	21	76	73	77	8.43	+2.1	15	4,068	se.	17	e.	1	3	18	10	6.2	.0	.0
West Gulf States							83.7	+1.1										72	2.20	−1.0										4.6		
Shreveport	249	92	227	29.73	29.99	+.01	84.8	+1.6	101	8	94	70	3	75	24	75	71	71	1.02	−2.5	3	5,771	se.	34	ne.	2	13	17	1	4.0	.0	.0
Bentonville	1,303	11	44	28.66	29.99	+.02	81.0	+2.5	97	31	92	63	14	70	27	----	----	----	1.72	−2.0	4	4,034	sw.	17	se.	2	8	20	3	----	.0	.0
Fort Smith	457	79	94	29.51	29.97	.00	85.0	+3.5	101	31	96	68	14	74	24	74	70	67	.85	−2.5	3	3,906	e.	21	e.	12	11	19	1	4.1	.0	.0
Little Rock	357	94	102	29.63	30.00	+.01	82.3	+1.4	98	31	91	68	3	73	26	74	71	72	2.34	−1.2	13	4,575	e.	27	ne.	22	10	16	5	4.7	.0	.0
Austin	605	136	148	29.34	29.97	----	84.4	+.4	103	9	94	69	15	74	26	73	69	69	1.44	−.9	6	4,754	se.	29	se.	18	12	14	5	4.2	.0	.0
Brownsville	57	88	96	29.87	29.93	----	83.8	+.2	94	9	91	72	17	76	22	76	74	79	.85	−1.1	7	6,759	se.	26	e.	25	9	19	3	4.8	.0	.0
Corpus Christi	20	11	78	29.93	29.95	−.01	84.0	+1.3	93	21	90	74	16	78	17	77	74	76	1.37	−.2	8	7,228	se.	27	e.	17	15	13	3	4.0	.0	.0
Dallas	512	220	227	29.42	29.96	----	84.6	----	104	9	94	70	22	75	26	74	71	69	.53	−2.3	6	6,641	se.	52	ne.	12	16	10	5	4.1	.0	.0
Fort Worth	679	92	110	29.28	29.98	+.02	85.1	+1.5	104	9	96	70	16	75	31	----	----	----	.89	−1.7	5	5,686	s.	25	e.	12	25	6	0	----	.0	.0
Galveston	54	106	114	29.92	29.98	.00	83.2	−.2	97	8	88	72	13	78	17	77	74	76	5.36	+1.6	14	6,323	s.	37	nw.	13	16	8	7	4.1	.0	.0
Houston	138	292	314	29.84	29.98	----	83.2	−.5	98	9	91	72	13	75	25	----	----	----	4.84	+.8	14	6,428	s.	34	n.	9	5	21	5	5.5	.0	.0
Palestine	510	64	72	29.47	29.99	+.02	83.4	+1.2	101	9	94	70	4	73	24	74	70	72	.95	−1.7	6	4,215	s.	25	s.	3	8	20	3	4.8	.0	.0
Port Arthur	34	58	66	29.94	29.98	----	83.4	----	101	9	91	73	15	76	23	76	74	76	7.08	+.1	16	4,312	s.	20	nw.	9	4	20	7	5.8	.0	.0
San Antonio	693	242	301	29.24	29.94	−.01	83.7	−.1	101	9	94	70	24	74	24	73	69	68	1.61	−.6	4	7,466	e.	32	s.	24	10	17	4	4.9	.0	.0
Ohio Valley and Tennessee							79.0	+2.6										72	4.09	+0.3										5.1		
Chattanooga	762	71	214	29.22	30.00	−.02	81.7	+3.3	98	31	92	67	16	72	29	72	68	69	1.65	−2.6	11	4,962	se.	29	s.	3	10	17	4	4.8	.0	.0
Knoxville	995	66	84	28.98	30.01	−.01	79.7	+2.6	95	12	90	65	4	70	27	71	67	73	4.91	+.6	12	3,535	w.	28	sw.	4	12	17	2	4.2	.0	.0
Memphis	399	78	86	29.57	29.99	−.01	82.6	+1.9	97	17	91	69	14	74	25	74	70	70	3.46	+.3	8	4,463	n.	24	n.	12	9	20	2	4.6	.0	.0
Nashville	546	168	191	29.45	30.01	.00	80.1	+1.0	95	31	90	65	15	71	29	72	68	72	4.50	+.6	9	5,300	nw.	30	se.	19	8	13	10	5.7	.0	.0
Lexington	989	6	----	28.98	30.01	.00	79.7	+3.8	95	12	90	65	4	70	27	71	67	73	4.91	+.6	12	3,535	w.	28	sw.	4	12	17	2	4.2	.0	.0
Louisville	525	188	234	29.44	30.01	+.01	80.2	+1.6	96	31	89	63	8	72	23	71	68	72	4.21	+.5	11	6,107	n.	37	w.	6	11	12	8	5.0	.0	.0
Evansville	431	76	116	29.54	30.00	.00	81.8	+2.9	102	31	91	65	9	73	27	72	68	69	2.53	−.9	6	4,818	n.	21	ne.	20	8	18	5	5.0	.0	.0
Indianapolis	822	194	230	29.14	30.00	+.01	78.6	+2.9	97	31	88	60	16	69	25	69	66	70	3.16	−.2	12	6,029	sw.	33	nw.	4	9	15	7	5.4	.0	.0
Terre Haute	575	96	129	29.37	29.98	----	81.0	----	100	31	91	60	16	71	28	73	69	72	3.89	+.7	9	5,199	sw.	23	sw.	5	15	9	7	4.2	.0	.0
Cincinnati	627	11	51	29.34	30.00	.00	78.8	+3.7	99	31	89	63	16	68	29	70	68	76	1.48	−1.8	12	4,206	sw.	21	sw.	3	10	10	11	5.4	.0	.0
Columbus	822	90	210	29.14	29.99	−.01	78.2	+3.3	93	20	88	60	30	68	28	69	65	70	4.83	+1.3	12	5,629	s.	30	s.	3	11	11	9	5.1	.0	.0
Dayton	900	58	153	29.06	29.99	----	78.4	+3.0	95	31	88	62	16	69	27	----	----	----	4.24	+1.0	11	4,969	sw.	26	nw.	4	9	12	10	----	.0	.0
Elkins	1,947	59	78	28.05	30.02	+.01	72.6	+2.3	88	12	83	55	30	62	28	66	64	82	8.76	+3.4	14	3,450	se.	19	n.	7	4	12	15	6.9	.0	.0
Parkersburg	637	77	84	29.38	30.04	+.03	77.6	+2.2	94	20	87	60	30	68	27	70	68	75	6.44	+2.2	11	3,769	se.	32	nw.	31	9	13	9	5.5	.0	.0
Pittsburgh	842	164	410	28.67	30.00	.00	76.0	+1.4	94	20	86	59	16	66	28	67	64	72	2.38	−1.7	13	6,117	sw.	31	w.	28	7	13	11	5.9	.0	.0

TABLE 1.—*Climatological data for Weather Bureau stations, July 1935*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	*° F.*	*° F.*	*° F.*		*° F.*	*° F.*		*° F.*	*° F.*	*° F.*	*° F.*	*%*	*In.*	*In.*		*Miles*								*0–10*	*In.*	*In.*
Lower Lake Region							75.4	+3.9										71	4.64	+1.4										5.1		
Buffalo	768	243	280	29.16	29.96	−0.01	73.7	+3.9	90	6	80	57	27	68	28	67	63	71	1.34	−1.7	6	8,871	sw.	34	w.	19	15	10	6	4.5	0.0	0.0
Canton	448	10	61	29.47	29.93		71.9	+1.4	90	5	82	48	2	62	31				5.20	+1.7	12	5,478	sw.	24	se.	7	8	17	6	5.4	.0	.0
Ithaca	836	77	100	29.09	29.98		74.0	+3.5	96	6	85	48	2	63	36	67	64	75	12.59	+9.0	15	4,976	s.	27	nw.	12	8	17	9	6.1	.0	.0
Oswego	335	71	85	29.60	29.96	.00	73.4	+3.0	89	18	81	57	27	66	25	67	64	74	4.04	+1.1	12	5,781	s.	24	w.	6	7	14	10	5.6	.0	.0
Rochester	523	86	102	29.42	29.97	.00	75.6	+4.9	94	6	84	56	27	67	26	68	64	70	3.51	+.6	13	5,440	sw.	20	nw.	31	13	12	6	4.6	.0	.0
Syracuse	596	65	79	29.35	29.99	+.02	75.4	+4.6	94	6	85	55	2	66	29				6.14	+2.5	14	4,728	s.	26	sw.	19	5	17	9	5.9	.0	.0
Erie	714	130	166	29.23	29.98	.00	75.6	+4.6	92	18	83	59	17	68	24	68	64	70	7.54	+4.5	9	7,369	nw.	32	nw.	12	17	12	2	3.8	.0	.0
Cleveland	762	267	318	29.18	29.98	−.01	76.2	+4.8	92	18	83	63	2	69	23	68	64	70	2.61	−.8	11	7,713	n.	41	w.	12	11	13	7	4.6	.0	.0
Sandusky	629	5	67	29.32	30.00	+.01	77.4	+4.0	96	6	86	60	30	68	30				5.43	+2.0	12	5,315	sw.	18	sw.	23	8	12	11	5.4	.0	.0
Toledo	628	79	87	29.33	30.00	+.01	77.6	+4.4	97	19	86	62	16	69	26	63	64	68	1.17	−1.8	8	5,834	w.	21	nw.	19	15	9	7	4.3	.0	.0
Fort Wayne	857	69	84	29.08	29.99		77.2	+3.7	97	19	87	59	16	68	28	69	65	69	2.52	−1.1	8	5,318	nw.	34	s.	3	7	17	7	5.2	.0	.0
Detroit [1]	626	5	78	29.31	29.98	.00	76.2	+4.1	94	19	86	59	16	67	31	68	64	69	3.57	+.2	4	5,623	sw.	32	nw.	19	10	10	11	5.8	.0	.0
Upper Lake Region							72.7	+4.7										74	3.13	0.0										5.3		
Alpena	609	13	89	29.32	29.98	+.01	71.7	+5.8	93	11	81	51	16	63	26	65	62	72	1.54	−1.2	10	6,330	nw.	25	n.	20	12	15	4	4.6	.0	.0
Escanaba	612	54	60	29.31	29.96	−.01	70.4	+4.4	88	30	78	52	15	63	25	65	62	76	4.43	+1.1	12	6,662	s.	29	ne.	13	10	13	8	5.1	.0	.0
Grand Rapids	707	70	244	29.22	29.97	−.01	76.5	+4.2	96	19	86	57	16	67	28	68	64	69	5.17	+2.2	8	6,380	sw.	32	sw.	30	12	12	7	4.9	.0	.0
Lansing	878	6	88	29.06	29.97		73.8	+2.9	92	19	83	58	14	65	28	69	67	81	2.60	−.5	7	4,841	sw.	28	se.	19	11	9	11	5.6	.0	.0
Ludington	637	5	54																												
Marquette	734	77	111	29.16	29.95	−.01	69.8	+4.9	93	20	79	51	15	61	31	64	61	74	3.47	+.4	12	6,008	s.	39	sw.	30	8	14	9	5.7	.0	.0
Sault Sainte Marie	614	11	52	29.28	29.96	−.01	69.0	+5.2	93	5	80	51	16	58	40	62	58	72	.82	−2.1	8	4,857	w.	21	nw.	13	12	8	11	5.2	.0	.0
Chicago	673	7	131	29.28	30.00	+.02	76.8	+4.3	95	19	84	60	16	70	26	69	66	74	3.05	−.3	10	5,932	sw.	26	w.	5	11	7	13	5.3	.0	.0
Green Bay	617	109	141	29.31	29.95	−.02	75.4	+5.4	94	19	85	57	15	66	26	68	65	71	1.70	−1.8	9	6,533	s.	37	w.	11	9	8	14	5.7	.0	.0
Milwaukee	681	97	221	29.26	29.98	+.01	75.6	+5.5	97	19	83	61	3	68	27	68	64	69	3.59	+.8	8	7,357	sw.	40	n.	5	9	13	9	5.5	.0	.0
Duluth	1,133	5	47	28.74	29.93	−.02	68.1	+4.2	88	20	78	46	2	58	33	63	61	81	4.96	+1.2	16	6,771	ne.	37	nw.	27	9	14	8	5.3	.0	.0
North Dakota							74.6	+6.0										68	4.42	+1.9										3.8		
Moorhead, Minn	940	50	58	28.91	29.88	−.06	75.6	+7.5	96	29	87	55	7	64	37	68	64	68	2.13	−1.3	7	5,985	s.	28	nw.	3	9	13	9	4.8	.0	.0
Bismarck	1,674	8	57	28.14	29.87	−.06	75.8	+6.0	100	2	88	52	30	64	39	67	62	67	5.46	+3.2	7	6,458	e.	40	nw.	10	16	14	1	3.2	.0	.0
Devils Lake	1,478	11	44	28.37	29.91	−.02	73.4	+6.0	94	16	84	56	7	62	33	66	63	74	5.23	+2.7	12	5,599	se.	25	e.	8	13	13	5	4.3	.0	.0
Grand Forks	833	12	67				74.4		94	16	86	53	7	63	35	68			6.14		10		se.	35	sw.	20	8	21	2		.0	.0
Williston	1,878	41	48	27.95	29.88	−.04	73.6	+4.7	103	28	86	50	1	61	40	64	59	65	4.88	+3.0	13	5,637	se.	40	nw.	18	16	15	0	3.1	.0	.0
Upper Mississippi Valley							79.8	+4.7										71	3.04	−0.4										4.4		
Minneapolis	918	102	208	28.97	29.93	−.02	79.8	+7.5	98	27	90	60	7	70	27	70	65	64	2.59	−1.1	8	7,051	s.	35	nw.	5	10	12	9	4.5	.0	.0
La Crosse	714	11	48	29.19	29.93	−.03	77.9	+5.1	100	18	88	59	8	68	28	70	68	76	3.24	−.7	10	3,441	s.	18	nw.	10	8	16	7	5.3	.0	.0
Madison	974	70	78	28.95	29.97	.00	76.3	+4.2	94	18	85	60	16	68	26	70	67	75	2.49	−1.4	11	5,064	sw.	19	nw.	11	9	14	8	5.2	.0	.0
Charles City	1,015	10	51	28.91	29.96	.00	77.8	+5.5	96	18	88	58	13	68	27	70	67	72	1.10	−2.7	7	4,702	se.	18	se.	20	16	12	3	3.4	.0	.0
Davenport	606	66	161	29.34	29.99	+.02	81.0	+5.7	99	30	90	64	8	72	23	71	68	68	2.25	−1.1	11	5,758	sw.	27	ne.	14	11	9	11	5.0	.0	.0
Des Moines	861	5	99	29.08	29.96	.00	80.9	+5.5	99	28	91	65	14	71	26	72	69	70	3.06	−.4	9	6,052	se.	27	nw.	21	12	18	1	4.0	.0	.0
Dubuque	700	60	79	29.24	29.97	.00	79.2	+5.1	98	18	89	61	16	70	26	70	67	70	3.82	−.1	7	3,841	s.	18	n.	21	11	13	7	5.0	.0	.0
Keokuk	614	64	78	29.34	30.00	+.02	81.0	+4.1	97	28	90	65	16	72	25	72	69	69	4.85	+1.4	9	4,640	sw.	26	nw.	23	13	9	9	4.4	.0	.0
Cairo	358	87	93	29.61	29.99	−.01	81.2	+1.6	100	31	90	67	14	73	23	74	71	77	1.86	−1.2	7	4,606	n.	30	nw.	6	4	17	10	6.0	.0	.0
Peoria	609	11	45	29.35	30.01	+.03	79.2	+3.8	97	30	90	60	17	69	31	72	69	76	2.64	−.9	11	3,738	sw.	20	nw.	25	22	8	1	2.5	.0	.0
Springfield, Ill	636	5	191	29.32	29.99	+.01	81.4	+4.9	100	30	91	64	16	71	26	71	67	68	5.43	+2.6	7	6,464	s.	26	s.	3	16	10	5	3.9	.0	.0
St. Louis	568	265	303	29.40	29.99	.00	82.2	+3.6	100	30	91	68	8	74	22	73	69	70	3.13	+.2	6	6,469	sw.	33	nw.	6	15	11	5	3.8	.0	.0
Missouri Valley							83.1	+7.1										62	1.48	−2.2										2.7		
Columbia, Mo	784	6	84	29.17	29.98	.00	80.6	+3.7	97	30	91	63	14	71	26				3.89	+.4	7	4,603	se.	32	nw.	12	18	9	4	3.5	.0	.0
Kansas City [1]	750	32	45	29.17	29.95	−.02	86.8	+8.7	104	27	98	67	14	76	27	74	69	61	.51	−3.6	4	6,358	sw.	37	nw.	12	20	9	2	2.9	.0	.0
St. Joseph	967	11	49	28.95	29.94		85.1		102	28	96	64	13	74	28	73	69	63	.11	−3.6	1	5,404	se.	27	nw.	12	27	4	0	1.5	.0	.0
Springfield, Mo	1,324	98	104	28.63	30.00	+.02	80.6	+3.8	96	30	90	65	13	72	22	72	68	71	1.62	−2.6	5	5,520	se.	26	se.	18	25	6	0	2.1	.0	.0
Iola	984	11	50	28.96	29.97	.00	83.9	+5.7	100	31	96	64	13	72	32				.63	−3.1	2		s.				20	9	2		.0	.0
Topeka	987	65	87				87.0	+9.2	106	31	100	66	13	74	30				.03	−4.2	3	6,205	s.	21	ne.	12	24	7	0	1.8	.0	.0
Lincoln	1,189	11	81	28.69	29.91	−.04	85.0	+8.5	105	31	97	61	14	73	34	72	67	61	3.83	.0	5	7,016	s.	37	ne.	23	19	12	0	3.1	.0	.0
Omaha [1]	1,105	170	200	28.91	29.92	−.03	83.7	+7.0	103	28	95	64	13	72	31	73	69	68	1.11	−2.4	5	7,116	se.	34	nw.	8	18	12	1	2.7	.0	.0
Valentine	2,598	47	54	27.28	29.92	−.01	80.4	+6.7	106	27	93	58	5	67	33	66	59	53	1.30	−1.7	9	6,654	s.	34	sw.	3	17	13	1	3.1	.0	.0
Sioux City	1,138	64	106	28.73	29.90	−.05	82.8	+8.5	104	27	94	62	13	72	33	71	66	62	2.02	−1.5	8	6,574	se.	26	ne.	23	16	9	6	3.9	.0	.0
Huron	1,306	60	74	28.54	29.89	−.05	80.6	+8.8	105	26	94	57	13	68	39	68	62	58	1.19	−2.0	10	6,892	se.	29	ne.	26	19	11	1	2.4	.0	.0
Northern Slope							72.2	+4.3										48	1.05	−0.6										3.4		
Billings	3,570	17	31																												
Havre	2,505	11	67	27.32	29.90	−.01	73.2	+4.9	101	15	89	46	2	58	43	57	46	49	1.64	−.2	13	5,942	sw.	35	sw.	6	17	13	1	2.7	.0	.0
Helena	4,124	85	111	25.82	29.92	−.01	68.8	+3.1	99	27	82	37	1	55	41	53	42	44	1.03	−.1	11	6,272	sw.	29	w.	2	13	11	7	4.3	.0	.0
Kalispell	2,973	48	56	26.94	29.94	+.01	65.2	+1.1	96	27	80	40	2	51	41	53	43	53	1.11	.0	9	4,905	w.	25	se.	25	16	13	2	8.5	.0	.0
Miles City	2,371	48	55	27.41	29.89	−.03	78.5	+5.6	108	28	92	55	1	64	36	63	53	49	1.83	+.3	6	4,908	ne.	39	nw.	8	23	8	0	2.4	.0	.0
Rapid City	3,259	50	58	26.61	29.92	−.01	77.2	+6.2	104	26	90	56	5	64	38	62	53	46	.90	−1.5	7	5,670	w.	28	sw.	28	19	10	2	3.4	.0	.0
Cheyenne	6,094	50	71	24,13	29.95	+.03	69.8	+3.1	93	26	84	47	5	56	38	55	48	53	1.94	−.2	12	5,814	w.	28	w.	1	16	14	7	4.9	.0	.0
Lander	5,372	60	68	24.70	29.90	−.02	71.8	+4.4	102	27	89	44	1	55	48	53	39	38	.29	−.4	6	4,420	sw.	26	sw.	4	15	13	3	4.1	.0	.0
Sheridan	3,790	10	47	26.09	29.90		73.8		105	28	92	45	1	56	47	58	47	49	.09	−1.1	3	4,001	se.	27	nw.	10	23	6	2	2.6	.0	.0
Yellowstone Park	6,241	11	48	23.98	29.95	+.03	64.2	+2.7	90	27	81	36	1	48	44	49	38	46	.52	−.8	5	5,919	sw.	30	sw.	16	17	12	2	3.3	.0	.0
North Platte	2,821	11	51	27.05	29.89	−.04	80.9	+8.0	102	29	94	56	15	68	37	67	61	56	1.17	−1.6	7	5,221	s.	24	ne.	22	21	9	1	2.8	.0	.0
Middle Slope							81.8	+4.6										52	0.91	−1.9										2.9		
Denver	5,292	106	113	24.82	29.94	+.03	74.8	+2.6	97	26	87	57	15	62	33	57	48	46	1.32	−0.4	11	5,706	s.	27	nw.	3	10	18	3	4.3	.0	.0
Pueblo	4,685	80	86	25.34	29.89	−.02	78.2	+4.0	98	27	92	59	16	64	36	58	46	40	.30	−1.6	3	5,183	nw.	28	w.	22	20	11	0	3.3	.0	.0
Concordia	1,392	50	58	28.51	29.94	−.01	84.8	+6.8	107	11	97	64	13	73	31	71	65	56	1.23	−2.6	7	6,312	s.	26	sw.	4	27	4	0	1.9	.0	.0
Dodge City	2,509	10	86	27.41	29.93	.00	83.6	+5.2	106	11	96	62	13	71	36	66	57	48	1.09	−2.0	5	9,354	s.	38	e.	8	24	7	0	1.7	.0	.0
Wichita	1,358	85	93	28.55	29.93	−.03	84.6	+5.2	102	11	95	64	13	74	28	71	64	56	.39	−3.0	3	7,841	sw.	31	sw.	23	23	7	1	2.2	.0	.0
Oklahoma City	1,214	10	47	28.72	29.97	+.01	84.6	+4.0	103	12	93	68	13	74	32	72	67	63	1.11	−1.8	3	5,998	s.	16	s.	1	16	11	4	4.0	.0	.0

[1] Observations taken at airport.

TABLE 1.—*Climatological data for Weather Bureau stations, July 1935*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01, or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	*Ft.*	*Ft.*	*In.*	*In.*	*In.*	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	*In.*	*In.*		*Miles*								*0-10*	*In.*	*In.*
Southern Slope							81.1	−0.1										58	1.43	−1.0										3.5		
Abilene	1,738	10	52	28.19	29.95	+0.02	83.4	+0.6	103	10	95	64	14	72	29	70	64	61	1.73	−0.4	8	6,056	s.	27	w.	20	18	9	4	3.7	0.0	0.0
Amarillo	3,676	10	49	26.33	29.96	+.04	80.1	+3.3	101	11	92	62	16	68	29	64	57	53	.81	−2.0	4	6,844	s.	23	se.	22	18	11	2	3.1	.0	.0
Del Rio	944	64	71	28.93	29.89	−.01	82.6	−3.7	98	9	92	69	13	74	26	72	68	67	2.77	+.4	7	6,656	se.	24	n.	13	12	8	11	5.1	.0	.0
Roswell	3,566	75	85	26.40	29.92	+.04	78.2	−.7	99	31	91	58	16	65	33	63	54	49	.41	−1.8	3	5,918	s.	28	n.	21	23	7	1	2.2	.0	.0
Southern Plateau							79.9	+0.9										42	0.54	−0.6										3.5		
El Paso	3,778	152	175	26.18	29.84	.00	84.0	+2.9	100	22	95	66	16	73	28	64	53	40	.16	−1.8	5	6,401	e.	30	nw.	31	26	4	1	2.3	.0	.0
Albuquerque	4,972	5	39	25.10	29.83	.....	77.2	.....	98	11	92	56	1	62	37	58	48	44	.19	−1.2	7	6,029	se.	34	w.	2	16	10	5	4.2	.0	.0
Santa Fe	7,013	38	53	23.39	29.89	+.01	70.6	+1.6	89	10	83	52	3	58	31	55	46	48	1.89	−.5	11	4,532	e.	22	n.	17	5	22	4	5.2	.0	.0
Flagstaff	6,907	10	59	23.46	29.87	+.04	65.8	+.8	92	26	81	35	4	50	45	51	.....	51	.99	.....	6	.....	nw.	30	s.	3	8	11	12	.....	0	.0
Phoenix	1,108	10	107	28.66	29.77	−.01	92.0	+2.2	112	26	106	68	4	78	37	67	51	30	.93	−.1	3	4,736	w.	30	n.	16	13	14	4	3.9	.0	.0
Yuma	141	9	54	29.62	29.76	.00	91.3	+.5	111	17	105	65	4	77	37	70	58	39	T	−.2	0	4,701	s.	21	s.	18	23	8	0	2.6	.0	.0
Independence	3,957	5	26	25.93	29.88	+0.5	75.7	−2.4	101	13	93	50	8	58	41	54	.....	.....	.05	−.1	2	.....	s.	.....	.....	.....	24	5	2	.....	.0	.0
Middle Plateau							73.9	+1.5										33	0.34	−0.2										2.7		
Reno	4,527	61	76	25.47	29.88	+.01	69.4	+1.9	99	14	86	42	7	53	41	51	37	38	.02	−.2	1	5,376	w.	27	s.	13	23	7	1	1.6	.0	.0
Tonopah	6,090	12	20	.....	.....	.....	71.9	.....	94	13	84	44	2	60	30	50	32	28	.89	.....	5	.....	se.	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winnemucca	4,344	18	56	25.60	29.89	−.01	72.0	+1.4	105	14	90	42	9	54	48	50	33	30	.01	−.2	1	5,704	sw.	21	nw.	4	21	8	2	2.3	.0	.0
Modena	5,473	10	46	24.65	29.87	+.01	69.8	−.8	94	13	88	41	3	52	45	51	37	39	1.51	+.4	6	8,367	sw.	36	nw.	15	19	8	4	2.8	.0	.0
Salt Lake City [1]	4,357	86	210	25.69	29.83	−.07	78.4	+2.7	101	13	94	48	1	63	46	56	39	30	.04	−.5	2	7,977	se.	40	w.	28	21	9	1	2.4	.0	.0
Grand Junction	4,602	60	68	25.39	29.88	−.01	80.1	+2.4	99	26	93	59	4	67	37	59	45	35	.10	−.5	3	5,538	se.	24	s.	18	10	19	2	4.2	.0	.0
Northern Plateau							72.3	+1.7										38	0.23	−0.3										2.6		
Baker	3,471	48	53	26.45	29.97	+.02	66.8	+1.2	101	14	83	37	1	51	46	52	39	45	.20	−.3	3	4,463	n.	32	w.	15	21	7	3	2.7	.0	.0
Boise	2,739	79	87	27.10	29.89	−.04	74.2	+1.3	105	14	89	40	1	59	39	56	41	37	.03	−.2	1	4,194	nw.	21	se.	5	26	4	1	1.9	.0	.0
Pocatello	4,477	60	68	25.46	29.86	−.06	73.8	+3.0	101	15	90	44	1	58	42	52	33	28	.08	−.7	4	6,383	se.	28	sw.	4	26	4	1	1.5	.0	.0
Spokane	1,929	101	110	27.93	29.94	−.02	70.2	+1.2	99	14	84	44	9	56	39	55	43	45	.68	.0	7	4,774	s.	22	sw.	28	13	11	7	4.1	.0	.0
Walla Walla	991	57	65	28.87	29.92	−.05	75.0	+1.0	109	14	88	51	2	62	38	56	41	35	.20	−.2	3	4,755	w.	24	w.	31	22	7	2	2.6	.0	.0
Yakima	1,076	58	67	28.81	29.94	.....	73.7	+2.3	106	14	87	48	2	60	38	57	44	40	.12	−.2	5	5,771	nw.	22	nw.	24	17	12	2	3.0	.0	.0
North Pacific Coast Region							62.7	+0.8										68	0.52	−0.2										4.8		
North Head	211	11	56	29.86	30.08	.00	57.4	+.2	72	13	61	50	6	54	19	54	53	86	.46	−.5	8	8,812	n.	33	n.	2	6	8	17	6.3	.0	.0
Seattle	125	90	321	29.90	30.03	−.01	64.9	+1.8	94	14	74	51	3	55	32	57	51	65	.79	+.2	9	5,941	n.	22	s.	8	12	8	11	4.9	.0	.0
Tatoosh Island	86	10	54	29.98	30.07	+.02	55.0	−.1	67	13	58	48	19	52	14	53	51	89	1.13	−.4	9	7,152	s.	29	s.	15	6	7	18	7.0	.0	.0
Medford	1,329	29	58	28.58	29.96	.....	69.9	.....	102	14	86	43	6	54	44	56	46	50	.32	.0	2	5,154	nw.	25	nw.	27	21	5	5	2.9	.0	.0
Portland, Oreg	153	68	106	29.87	30.03	−.02	67.8	+1.1	105	13	79	49	6	57	35	58	52	62	.28	−.3	4	4,951	nw.	16	nw.	12	12	10	9	5.0	.0	.0
Roseburg	510	45	76	29.48	30.02	−.01	68.3	+.9	104	13	82	42	8	54	43	57	49	58	.11	−.2	2	4,222	n.	19	ne.	16	16	13	2	3.0	.0	.0
Middle Pacific Coast Region							63.3	+0.9										61	0.03	0.0										2.8		
Eureka	62	73	89	29.98	30.05	.00	55.3	−.2	65	27	60	46	7	51	16	53	51	89	.09	.0	5	5,103	n.	30	n.	1	13	7	11	5.1	.0	.0
Redding	722	20	34	.....	.....	.....	79.8	.....	109	17	92	55	7	67	36	58	41	30	T	.....	0	6,238	nw.	25	nw.	14	24	5	2	1.7	.0	.0
Sacramento	66	92	115	29.80	29.87	−.01	74.4	+1.2	108	16	90	52	7	58	42	59	47	47	T	.0	0	6,111	s.	21	s.	19	29	2	0	.9	.0	.0
San Francisco	155	208	243	29.77	29.94	−.01	60.2	+1.7	82	16	68	51	7	52	29	54	50	78	T	.0	0	6,190	sw.	26	sw.	5	18	8	5	3.4	.0	.0
South Pacific Coast Region							72.9	−0.2										61	T	0.0										2.5		
Fresno	327	97	105	29.51	29.86	+.03	80.2	−1.9	110	18	96	54	7	64	38	60	45	35	T	.0	0	5,318	nw.	17	nw.	5	28	3	0	.9	.0	.0
Los Angeles	338	159	191	29.56	29.91	+.01	70.8	+.6	96	15	80	56	3	61	29	61	56	67	T	.0	0	3,984	s.	15	w.	13	24	5	2	2.3	.0	.0
San Diego	87	62	70	29.82	29.91	−.01	67.8	+.6	80	28	73	58	3	63	17	63	61	82	T	.0	0	4,961	w.	18	s.	1	18	12	1	4.2	.0	.0
West Indies																																
San Juan, P. R	82	9	54	29.94	30.02	.....	80.0	−.1	89	6	84	72	13	76	13	.....	.....	.....	4.66	−1.3	18	10,659	e.	29	e.	13	2	26	3	5.7	.0	.0
Panama Canal																																
Balboa Heights	118	6	97	.....	[3] 29.81	−.02	80.1	−.2	92	13	86	72	21	74	17	.....	.....	[3] 88	13.16	+5.8	19	3,934	nw.	26	sw.	7	0	7	24	8.1	.0	.0
Cristobal	36	6	97	.....	[3] 29.83	−.01	80.8	+.4	90	11	86	73	3	76	16	77	76	[3] 86	26.23	+10.6	28	4,900	w.	26	n.	4	1	6	24	8.7	.0	.0
Alaska																																
Fairbanks	454	11	87	[3] 29.39	[3] 29.89	.....	61.1	.....	84	8	72	41	28	50	37	54	48	68	1.97	.....	15	4,648	sw.	24	sw.	21	7	10	14	6.3	.0	.0
Juneau	80	96	116	[3] 29.98	[3] 30.07	.....	55.2	.....	73	26	60	46	3	51	25	52	49	83	7.18	.....	23	3,820	s.	20	se.	13	4	2	25	8.5	.0	.0
Hawaiian Islands																																
Honolulu	38	86	100	[3] 29.96	[3] 30.00	.....	78.0	+.3	84	16	83	71	11	74	13	70	67	71	1.18	.0	16	7,290	e.	29	ne.	24	5	14	12	6.3	.0	.0

[1] Observations taken at airport.

[2] Observations taken bihourly.

[3] Pressure not reduced to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, July 1935*

Stations	Altitude above mean sea level, Jan. 1, 1919	Pressure			Temperature of the air						Precipitation		
		Station reduced to mean of 24 hours	Sea level reduced to mean of 24 hours	Departure from normal	Mean max.+ mean min.÷2	Departure from normal	Mean maximum	Mean minimum	Highest	Lowest	Total	Departure from normal	Total snowfall
	Feet	*In.*	*In.*	*In.*	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*	*° F.*	*In.*	*In.*	*In.*
Cape Race, Newfoundland	99												
Sydney, Cape Breton Island	48												
Halifax, Nova Scotia	88												
Yarmouth, Nova Scotia	65												
Charlottetown, Prince Edward Island	38												
Chatham, New Brunswick	28												
Father Point, Quebec	20	29.80	29.82	−0.03	59.4	+1.8	68.1	50.8	80	40	2.51	−0.53	0.0
Quebec, Quebec	296	29.63	29.95	+.04	68.2	+2.7	76.5	59.9	84	49	10.11	+5.85	.0
Doucet, Quebec	1,236				63.6		76.3	51.0	89	30	4.05		.0
Montreal, Quebec	187												
Ottawa, Ontario	236												
Kingston, Ontario	285												
Toronto, Ontario	379	29.56	29.95	−.02	73.9	+5.9	82.9	64.9	93	57	3.59	+.67	.0
Cochrane, Ontario	930												
White River, Ontario	1,244	28.64	29.92	−.02	65.4	+5.9	78.2	52.5	92	40	6.02	+3.22	
London, Ontario	808												
Southampton, Ontario	656	29.27	29.98	+.01	70.9	+6.2	79.9	61.9	89	54	1.57	−.41	.0
Parry Sound, Ontario	688	29.27	29.95	−.01	71.9	+5.9	81.0	62.9	88	52	2.24	−.38	.0
Port Arthur, Ontario	644	29.26	29.95	+.01	66.6	+4.6	75.2	58.0	90	48	4.82	+1.34	.0
Winnipeg, Manitoba	760	29.08	29.89	−.04	72.3	+6.3	82.4	62.3	90	53	1.92	−1.16	.0
Minnedosa, Manitoba	1,690	28.14	29.91	−.02	69.0	+6.8	79.0	59.1	85	50	5.92	+3.32	.0
Le Pas, Manitoba	860		29.86		68.9		79.3	58.6	89	51	1.91		.0
Qu'Appelle, Saskatchewan	2,115												
Moose Jaw, Saskatchewan	1,759												
Swift Current, Saskatchewan	2,392												
Medicine Hat, Alberta	2,365	27.45	29.88	−.02	70.5	+2.7	84.3	56.7	101	44	1.47	−.62	.0
Calgary, Alberta	3,540												
Banff, Alberta	4,521												
Prince Albert, Saskatchewan	1,450												
Battleford, Saskatchewan	1,592												
Edmonton, Alberta	2,150												
Kamloops, British Columbia	1,262												
Victoria, British Columbia	230												
Barkerville, British Columbia	4,180												
Estevan Point, British Columbia	20												
Prince Rupert, British Columbia	170												
Hamilton, Bermuda	151												

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Cape Race, Newfoundland	99				48.2		52.9	43.5	63	38	6.40		0.0
Halifax, Nova Scotia	88	29.74	29.84	−0.11	57.2	−0.5	64.4	50.0	75	41	3.48	−0.28	.0
Yarmouth, Nova Scotia	65	29.85	29.92	−.03	56.9	+1.9	64.8	49.0	73	38	4.02	+1.09	.0
Charlottetown, Prince Edward Island	38	29.87	29.91	−.01	60.6	+3.2	69.5	51.8	79	39	3.00	+.33	.0
Chatham, New Brunswick	28	29.82	29.85	−.04	60.8	+.8	70.7	50.9	82	35	3.16	−.30	.0
Father Point, Quebec	20	29.85	29.87	.00	54.2	+1.2	62.3	46.1	78	40	4.20	+1.22	.0
Ottawa, Ontario	236	29.63	29.89	−.05	62.3	−3.0	72.5	52.2	83	41	6.00	+3.08	.0
London, Ontario	808				61.2		71.2	51.2	82	36	4.60		.0
Southampton, Ontario	656	29.19	29.90	−.07	59.0	−1.4	68.7	49.3	83	40	2.98	+.63	.0
Parry Sound, Ontario	688	29.21	29.89	−.07	60.8	−.9	70.2	51.5	81	43	5.38	+2.96	.0
Port Arthur, Ontario	644	29.16	29.87	−.07	56.1	−.3	64.6	47.6	79	37	2.54	−.19	.0
Winnipeg, Manitoba	760	29.00	29.82	−.07	57.7	−4.5	67.5	48.0	84	29	4.15	+.86	.0
Qu'Appelle, Saskatchewan	2,115	27.58	29.80	−.07	55.3	−4.6	64.5	46.2	83	33	5.54	+2.12	.0
Moose Jaw, Saskatchewan	1,759				58.2		69.0	47.3	86	32	2.04		.0
Swift Current, Saskatchewan	2,392	27.31	29.79	−.08	58.4	−1.6	69.3	47.6	88	48	3.64	+.97	.0
Banff, Alberta	4,521	25.33	29.85	+.01	50.7	−.8	62.4	39.0	74	29	2.97	−.36	.0
Battleford, Saskatchewan	1,592	28.13	29.85	−.01	57.6	−1.9	68.4	46.7	89	32	2.61	−.70	.0
Edmonton, Alberta	2,150	27.59	29.83	−.01	58.3	+1.4	67.4	49.1	83	38	3.80	+.94	.0
Kamloops, British Columbia	1,262	28.61	29.88	+.01	64.3	+.5	77.3	51.4	89	43	1.32	−.10	.0
Estevan Point, British Columbia	20				54.5		59.5	49.5	70	45	6.11		.0
Prince Rupert, British Colombia	170				51.6		57.3	46.0	70	40	2.93		.0

SEVERE LOCAL STORMS, JULY 1935

(Compiled by Mary O. Souder; authorities, U. S. Weather Bureau officials)

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Wisconsin, western and northwestern counties.	1-2					Heavy rain	Number of washouts of railroad tracks and highways.
Johnston (near), S. C.	2	P. m.			$1,200	Electrical	Tenant house, garage, and automobile destroyed.
Des Moines, Iowa, and vicinity.	2					Torrential rains	Over 50 square blocks of Valley Junction, suburb of Des Moines, flooded by Walnut Creek; Jordan Creek caused thousands of dollars' damage as it spread through the grounds of the Penn-Dixie Cement Co.; in some places railroad and street car tracks were washed out; highest flood that ever occurred in this section.
Grand Rapids, Mich.	3					Excessive rain	1.49 inches fell in 1 hour; streets, roads, and basements flooded; water in places curb deep in streets; section of railroad track washed out; crops and gardens ruined; loss of several thousand dollars.
Polk and Norman Counties, Minn.	3	12:30-1 p. m.		3	100,000	Tornado	Storm apparently originated in Dunn County, N. Dak.; 8 persons injured; 33 barns, many outbuildings, silos, and windmills demolished or badly damaged; windows broken, trees uprooted; poles down; loss to crops; path 45 miles long.
Indianapolis, Ind.	4	2:42-7:16 a. m., 2:43-8:12 p. m.				2 thunderstorms and excessive rain.	Lightning damaged power lines and caused several fires; many basements flooded; second storm in p. m. was accompanied by heavy rains and squalls which again flooded streets and cellars; some damage by blowing down signs and branches of trees.
Key West, Fla.	4	7-8:25 p. m.				Electrical	Transformer struck by lightning; business sections in darkness for an hour; considerable telephone trouble.
Butler, Okla. (10 miles west)	4	10:30 p. m.	[1] 4		10,000	Wind	Farm buildings and machinery wrecked to extent of $8,000; crop loss, $2,000.
Hunter's Station, Wyo.	4		[1] 6			Heavy hail	Path of storm 12 miles long; no details.
Knoxville, Tenn.	4				4,500	Thunderstorm	Trees and power lines leveled.
Red Wing, Minn.	5	4 a. m.		0	900	Small tornado	Trees uprooted; fruit knocked off; buildings damaged; few wires down.
Chicago, Ill.	5	11:40 a. m.-1:25 p. m.				Thunder squall and heavy rain.	Wind of 51 miles per hour recorded; damage to trees and power lines; number of small craft capsized in Lake Michigan.
Canutillo, Tex.-La Union, N. Mex.	5	2:30 p. m.	[1] 1		45,000	Hail	Crops, in area 1 by 4 miles, total loss.
Cambria and Christianburg, Va.	5	5:30-7:30 p. m.	880		1,600	Cyclonic winds, electrical.	Large building unroofed and debris carried 400 feet; roof of church carried some distance; feed water-damaged; small crop loss; all members of one family stunned by lightning.
Fairchild, Wis.	5	5:45 p. m.	33-167	0	12,000	Tornado	2 barns, a house, and filling station completely destroyed; much damage to power station; small damage to other buildings; path 3 miles long.
La Crosse County, Wis.	5	6:30 p. m.			6,000	Squall	Number of farm buildings wrecked.
Edgar, Marathon, and Wausau, Wis., and vicinity.	5	7:15-7:30 p. m.	100-167	0	125,000	Tornado	Started 10 miles west of Edgar, traveled eastward 4 miles wrecking 6 barns and a schoolhouse; storm lifted and skipped about 12 miles, reaching Marathon about 7:30, continued eastward through a portion of Wausau with damage amounting to $30,000 in Wausau alone; path 25 miles long.
Opelika, Ala., 3 miles south	5					Heavy rain	A trestle and 30 to 40 feet of track of the Western Railway of Alabama washed out.
Scranton, Pa.	6	P. m.				Thundersquall	Rainfall 1.68 inches; many streets flooded interrupting trolley service; 50 trees blown down; number of places struck by lightning.
Danbury, Conn.-Rhode Island.	6					Thunderstorm	Storm severe; Waterbury had 10 fires; poles down and trees destroyed; in Waterbury and Danbury over main thoroughfare to New York, water stood 2 feet deep; Veteran's Hospital at Newington struck by lightning; storm general north of New Haven.
Ithaca, N. Y.	6-8			11	4,000,000	Heavy rain	4 railroads running into Ithaca had tracks washed out; main automobile roads severely damaged; bridges and culverts were out in all directions; property damaged; crop loss; 11 persons drowned.
Todd County, S. Dak.	7	5-7 p. m.	[1] 6		30,000	Wind and rain	Damage to roads, bridges, and fences, $10,000; loss to crops, $20,000.
Glen Lyn, Va.	7	7:15-10 p. m.	[1] 15		125,000	Wind, electrical, and rain.	Loss estimated for Electric Power Co. only; small loss to crops.
Rochester, N. Y.	7	P. m.			500,000	Thunderstorm	Storm one of the most severe ever recorded in this section, both electrically and as to the amount of rainfall in a short period, 1.98 inches falling in 30 minutes; damage chiefly due to backing up of sewers and flooding cellars.
Oswego County, N. Y., southern portion.	7				25,000	Electrical, excessive rain.	2 barns burned with $25,000 loss; much damage from heavy rain in vicinity of Fulton; lightning caused 3 fires; cellars flooded and drives washed out; 5 miles south of Phoenix, 100 feet of N. Y. C. R. R. washed out.
New York State, south-central portion.	7-8			40	25,000,000	Torrential rain and flood.	Heaviest rainfall occurred over an area extending from Keuka Lake to central Chenango County, where 9 to over 10 inches fell during the 2-day period. The unprecedented rainfall brought many of the streams to flood peaks so sudden and high that people, caught practically unaware, were trapped in houses, automobiles, and cottages on the shores of the Finger Lakes; on July 8, creeks, usually insignificant in summer, discharged water many feet deep through the centers of Urbana, Hammondsport, Watkins Glen, Montour Falls, Myers, Trumansburg, Marathon, Lisle, Willett, and other towns; trees, buildings and other debris jammed bridges and culverts; streams were diverted; roads washed out; houses demolished; fields deeply gullied or buried under gravel; railroads washed out and bridges carried away; great damage through innundation; thousands of acres of highly productive muck and bottom lands submerged; residential and business sections in Hornell, Binghamton, Ithaca, Bath, and many other towns flooded; loss to State highways approximately $3,000,000, of which amount $1,750,000 was damage to bridges; damage to roads greater; 540 bridges of a span greater than 5 feet to be replaced; loss to railroads, exclusive of business, in excess of $1,250,000; heavy damage to public utilities, Watkins Glen, Enfield, and Taughannock Falls; property damage in millions.
Bloom, Kans., vicinity of	8			0	150	Tornado	Damage to outbuildings.
Valley County, Mont.	8			2		Wind	Many persons injured.
Charleston, S. C.	8					Heavy rain squall	This very heavy rain squall broke all July records for heavy precipitation for 30 minutes in this section.
Elkins, W. Va.	8					Heavy rain	3.7 inches of rain fell in 2½ hours; sewer system inadequate; in many places water 2 to 3 inches deep, breaking all records for heavy rainfall in short periods.
Norfolk, Va.	9	P. m.			15,000	Thunderstorm	Man received a severe burn on the hand resulting from lightning striking a knife he held; traffic delayed; electric service disrupted in many sections of the city; Smith-Douglas fertilizer plant damaged to the extent of $15,000.
Clinton (near), Minn.	10	1 p. m.				Hail	Considerable damage to crops.

[1] Miles instead of yards.

SEVERE LOCAL STORMS, JULY 1935—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Hubbard and Cass Counties, Minn.	10	do			5,000	Wind and rain	Basements flooded; highways damaged; trees blown down; loss to growing crops; wind damage $500, from heavy rain $4,500.
Pittston-Wilkes-Barre, Pa., and vicinity.	10					Flood	Some 40 families forced from their homes in the southern portion; crops destroyed in lowlands along the Susquehanna River; Kirby Park at Wilkes-Barre flooded.
Gary, Minn.	11	8 a. m.		0	800	Tornado	Several garages, small buildings, and lumber sheds demolished; trees uprooted.
Trondhyem, Minn.	11	Noon			5,000	Tornado and heavy rain.	Barns, silos, windmills, and small buildings wrecked or damaged considerably; haystacks blown away; loss to crops; poultry killed; path 4 miles long.
Phlox, Wis.	11	5:30 p. m.	880	0	15,000	Tornado and heavy hail.	Several barns and smaller buildings damaged; boy suffered a broken leg.
Newberry (near), S. C.	11				500	Electrical	Storehouse containing wheat destroyed.
Granada, Colo., vicinity of.	11-12			9	110,775	Flood	Owing to heavy local downpours in the vicinity of Granada and Wolf Creeks, flood waters resulted, 9 persons being drowned; considerable property damaged; 10 to 12 inches of rain fell.
Jasper, Ark.	12	2:15 p. m.	100	0	75,000	Tornado	3 persons injured; property damaged.
Clinton, Okla.	12	4:30 p. m.	[1] 1		500	Wind and hail	Hail damage slight; damage from wind $500; path 5 miles long.
Cross Plains, Tex.	12	5 p. m.	880	0		Tornado	Buildings damaged; plate glass windows broken; trees uprooted.
Gordon, Nebr.	12	7 p. m.	[1] 2		10,000	Wind and hail	Property destroyed.
Dallas, Tex.	12	7:28-11:35 p. m.				Thundersquall	Property damaged.
Missouri (central portion of State), west to east.	12				37,000	Wind, heavy rain, electrical.	Damage reported at Lexington, Concordia, Sedalia, Columbia, Jefferson City, Montogomery City, New Haven, St. Charles and St. Louis; damage at Jefferson City, $25,000; at Montgomery City, $10,000, and at St. Louis, $2,000.
Dryden-Cortland, N. Y.	12			0		Small tornado	Silo and 3 barns wrecked; apple and shade trees uprooted; telephone lines disrupted.
Columbia (near), S. C.	13	4 p. m.			1,000	Electrical	Lightning struck a mule shed killing 2 mules; building nearby containing harness and feed ignited and burned.
Tanners Lake, Minn., vicinity of.	14	2:30 p. m.			1,000	Wind	60-foot power pole blown down; branches of trees broken off; grain lodged.
Oelwein, Iowa, vicinity of.	14	p. m.	[1] 1			Tornadic wind, rain, and hail.	Several farm buildings completely destroyed; considerable crop loss.
Boscobel (near), Wis.	14		[1] 2		15,000	Heavy hail	Small grains, corn, orchards, and gardens severely damaged.
Bouse (near), Ariz.	16					Wind	1 person injured; 4 houses damaged.
Oswego County, N. Y.	16					Hail, wind, and rain	Near Kasoag a barn was blown from its foundation; in the vicinity of Pulaski a car was blown from the road; at New Haven thousands of dollars' damage to buildings and loss to crops; damage from hail in South New Haven and Volney; many trees blown down.
Napoleon, Ohio	16					Hail and wind	Storm severe, causing much loss to all crops.
Murdock, Minn.	17	6:15 p. m.				Wind and rain	Considerable damage to small grains.
Havre, Mont., and vicinity.	17	P. m.				Hail and wind	20,000 to 30,000 acres of crops lost; property damaged; poultry killed.
Philadelphia, N. Y.	19	3:30 p. m.	167	2	10,000	Small tornado	Storm first noted by members of the Leslie Drake farmstead, who were apprised of its approach by a terrible whistling noise and a funnel cloud. Before they could recover from their astonishment, the storm had "sideswiped" their buildings and passed on; a loaded hay wagon was overturned, the hay whisked away; part of the metal roof of the barn was torn loose; the funnel cloud passed on to the Earl Drake farm about 500 yards away and on the opposite side of the highway; 5 telephone poles were snapped off; granary and stock barn and farmhouse completely demolished; Mrs. Drake who was ill, 2 daughters and a child of 7, were in Mrs. Drake's room; Mrs. Drake, whose skull was fractured, died; her daughter, 19, sustained a broken back and other injuries, dying 2 days later; other daughter suffered from bruises and shock and the child had a broken rib and numerous bruises; path of storm 5 miles long.
Providence, R. I., and vicinity.	19	3:40-8:50 p. m.				Thunderstorm and hail.	About 20 buildings in the State struck by lightning and 3 men on the municipal golf course stunned.
Scranton, Pa., vicinity of.	19	6:10-8 p. m.				Thundersquall	4 houses struck by lightning.
New Haven, Conn.	19	6:20 p. m.				Electrical	No section of this State spared from the result of this storm; 2 men at Wallingford, 12 homes, and 3 churches struck by lightning, 6 fires resulting; light and telephone service disrupted.
Whitestown, Ind.	19					Heavy hail	Damage to crops.
New York State	19			8		Thunderstorm	8 persons killed by lightning; much property damage; house, sawmill, and many barns burned after being struck by lightning; trees uprooted; telephone and power lines damaged.
Toledo, Ohio, and vicinity.	19					Local squalls	Damage to trees and wires; amount not estimated.
Havre, Mont., and vicinity.	20	1:30 p. m.	[1] 5			Hail, wind, and rain	Gardens destroyed; grain in fields completely wiped out; property damaged.
Clear Spring, Md.	20	3:45 p. m.		2	10,000	Ball lightning, rain	Terrifically hot, depressing atmosphere, 99° temperature; 3 storms met; lightning in balls went running around the house, then a very large ball burst in the middle and a large flash of lightning struck a brick packing house instantly killing 2 men and shocking 10 others; 2:12 inches of rainfall recorded in 25 minutes.
Spink, Walworth, Edmunds and Potter Counties, S. Dak.	20	5-5:30 p. m.			88,480	Wind and hail	Farm buildings wrecked; loss to crops; most of damage in Walworth County.
Goshen, Ind.	20					Heavy hail	Damage to crops.
Des Moines, Iowa.	21					Thundersquall and hail.	High wind blew down trees, tied up traffic, and damaged property; 2 persons injured when a tree fell through their automobile.
Elkader (near), Iowa.	21					Wind and hail	Much damage to crops by hail; small grain blown down.
Artesia, N. Mex.	21		880		1,000	Wind	No details given.
Interlaken, N. Y.	21					Heavy rain	Cellars and stores flooded; railroad fill damaged.
Spink, Clark, and Codington Counties, S. Dak.	22	P. m.				Wind and hail	Several buildings damaged; loss to crops moderate.
Hamden and North Haven, Conn.	22				2,000	Electrical	Several buildings in North Haven struck by lightning; $2,000 estimated damage to barn by lightning.
Des Moines, Iowa.	23	6 a. m.		0	4,000	Small tornado	Storm centered on Glen Acres Flying Field; hangar demolished; 5 airplanes damaged.
Hollis, Okla., 8 miles north.	23	7 p. m.	[1] 1		11,000	Heavy hail	$10,000 crop loss; $1,000 other damage; path 4 miles long.
Liberal, Kans., vicinity of.	23	p. m.				Tornado	No damage reported.
Cheyenne, Wyo.	23	do		0		Rain and hail	Storm sewers inadequate; large portion of downtown section under water, at one point to the depth of 3 feet.
Pymosa, Franklin and Benton, Iowa.	23				10,000	Heavy hail	Stones as large as hen eggs; property damaged.
Richland, Iowa.	23				1,800	Wind	Loss to crops.
Miller, S. Dak., vicinity of.	24	9 p. m.	[1] 5-10			Hail	Do.
Walsenburg (near), Colo.	24					Heavy rain	Flooding; railroad bridge and about 850 feet of track washed out; damage to highways.
Grand Rapids, Mich.	24					do	Streets and basements flooded.
Milwaukee, Wis.	24			1		do	1.65 inches of rain in 30 minutes recorded; sewers overtaxed, streets and basements flooded; lawns damaged; boy drowned in creek.
Idaho County, Idaho, northwestern portion.	24-25		[1] 3			Wind, heavy rain	Damage to orchards by wind; silo demolished; heavy precipitation resulted in local floods in lower canyon; fences washed out; hay and bound grain carried away; path 10 miles long.

[1] Miles instead of yards.

SEVERE LOCAL STORMS, JULY 1935—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Adams County, Idaho, northern portion.	25	5 p. m.				Wind	Shacks demolished; trees uprooted.
Walworth, Edmunds and Hamlin Counties, S. Dak.	25	6–12 p. m.				Wind, rain, and hail	Buildings damaged; standing grain lodged; damage spotted.
Fairfield, Milford, and Connecticut River Valley, Conn.	25			4		Thunderstorm, excessive rain.	Fourth successive day of rain; considerable damage by lightning; 4 persons in separated sections of State drowned.
Aurora, Ill.	25				1,000	Electrical	House struck by lightning and burned.
Jefferson, Iowa, vicinity of	25					Heavy hail	Large hailstones; much crop loss.
Mitchell County, Iowa	25					Hail	Corn stripped; windows broken.
Leech Lake and Fisher, Minn., and vicinity.	26	P. m.				do	Light to heavy hail along the south shore of Leech Lake caused considerable damage to roofs of buildings and to corn; in Fisher about 40 percent of wheat crop damaged; path 25 miles long.
Lambert, Mont., vicinity of	26				10,000	Wind and hail	Roof of high school picked up and carried some distance where it landed on a Catholic Church badly damaging it; a public building under construction leveled and 2 garages picked up and scattered about, but cars in them unscratched; farms adjoining town heavily damaged; damage to power plant which was out of order for several hours.
Crosby, Minn., and vicinity	27	1:45 a. m.	880		3,000	Wind	Many windows broken; trees uprooted; Chimneys and poles down; slight damage to crops; path 1 mile long.
Salado, Tex.	27	2 p. m.	500	0	500	Tornado	Buildings damaged.
Utica, Minn., and vicinity	27	5:15 p. m.			350,000	Tornadic winds and excessive rain.	Several persons injured; many barns and small outbuildings demolished; houses unroofed and windows broken; trees uprooted; poles down; much poultry and livestock killed or injured; loss to crops; railroad tracks washed out; path 20 miles long.
Strong City, Okla.	27	11 p. m.	[1] 3		50,000	Severe hail	Some cattle killed; roofs of many houses badly damaged; crop loss; tons of large hailstones, some as large as hen eggs, washed into canyons and gullies where they were protected from the sun's rays and preserved for several weeks; path 5 miles long.
Plainview, Minn., and vicinity.	27	P. m.				Hail	Light to heavy hail that accompanied a tornado that centered in Utica, caused considerable damage to property and crops.
Globe, Ariz.	27					Heavy rain	Town hit by rush of water that washed debris and boulders into city streets and delayed transportation on the Miami highway.
Salt River Valley, Ariz.	27					Wind, electrical	Many trees broken down; 50 telephone poles broken off; in Buckeye, roof of building torn off and a barn demolished; hail leveled approximately 500 acres of cotton and damaged many acres of freshly-cut alfalfa seed; in Phoenix, 2 homes were struck by lightning and burned.
Hillsboro, Ohio	28				10,000	Severe hail and wind	Property damaged.
Lancaster, Ohio	28			1	1,500,000	Flood	Property damage, $1,500,000; 1 person drowned.
Buffalo, N. Y.	28				650	Thunderstorm	2 buildings struck by lightning.
Byers, Colo.	29	7:30–7:45 p. m.		0	1,000	Small tornado	Some damage to trees, windmills and buildings.
Bannock and Bear Lake Counties, Idaho.	31	2 p. m.	880		10,000	Hail	Crop loss; path 8 miles long.
Jeddito, Ariz.	31					Torrential rains	Thatcher–Pima district flooded, rail and highway traffic disrupted; numerous small houses damaged; portions of city water supply pipeline washed out; loss to crops.
Jefferson and Oldham Counties, Ky.	31				5,000	Wind	Damage to buildings, timber and wire systems; loss to crops.
Parkersburg, W. Va.	31–Aug. 1	p. m.				Severe thunderstorm.	Street cars out of commission at 11 p. m. until noon next day; wires down; streets flooded with from 6 to 18 inches of water; fills under street car and railway tracks washed out; 3,000 telephones out of order; motors stranded and many persons unable to return to their homes.

[1] Miles instead of yards.

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Chart I. Departure (°F.) of the Mean Temperature from the Normal, July 1935

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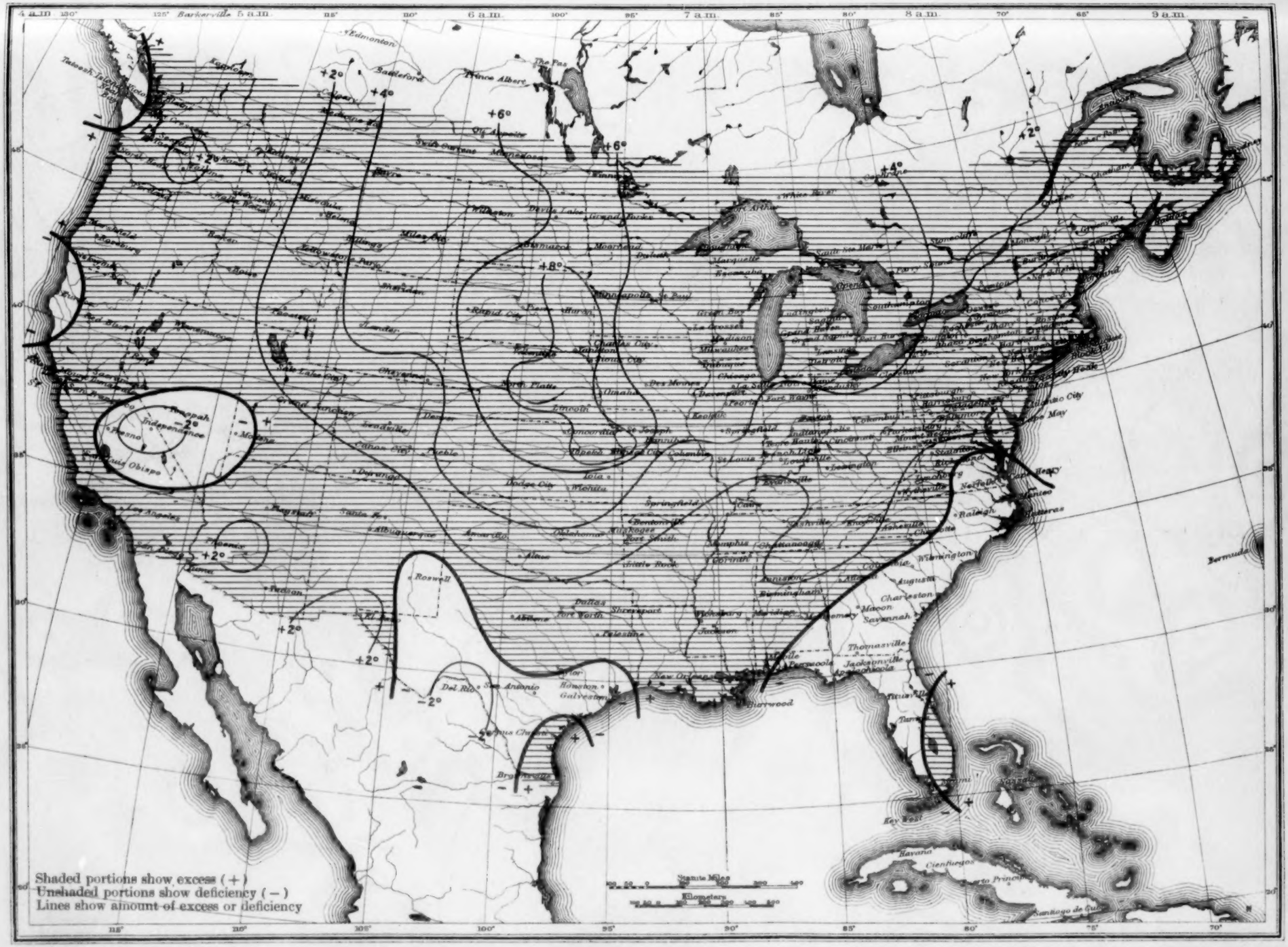
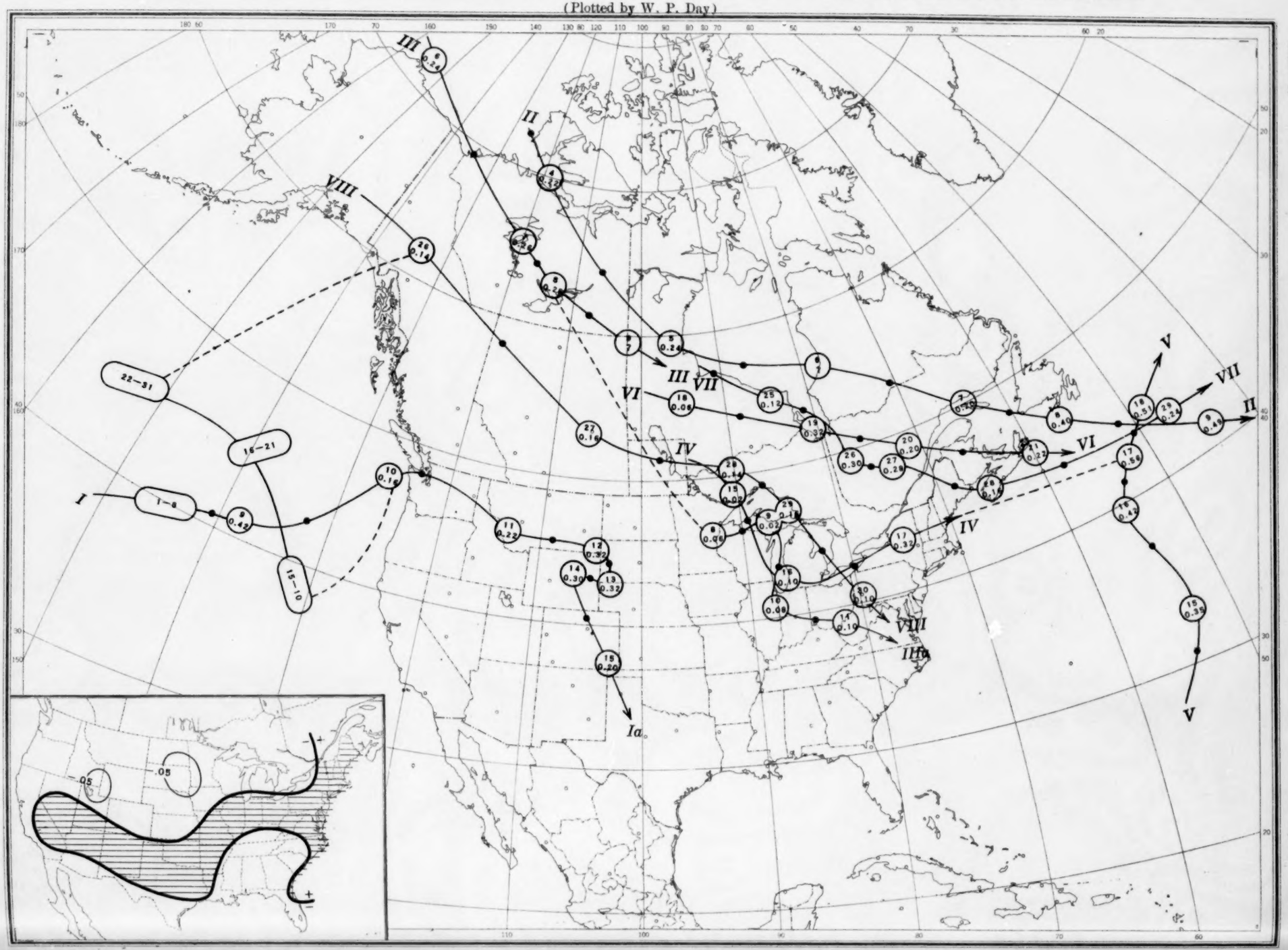

Shaded portions show excess (+)
Unshaded portions show deficiency (−)
Lines show amount of excess or deficiency
Statute Miles
Kilometers

Chart II. Tracks of Centers of Anticyclones, July 1935. (Inset) **Departure of Monthly Mean Pressure from Normal**

(Plotted by W. P. Day)



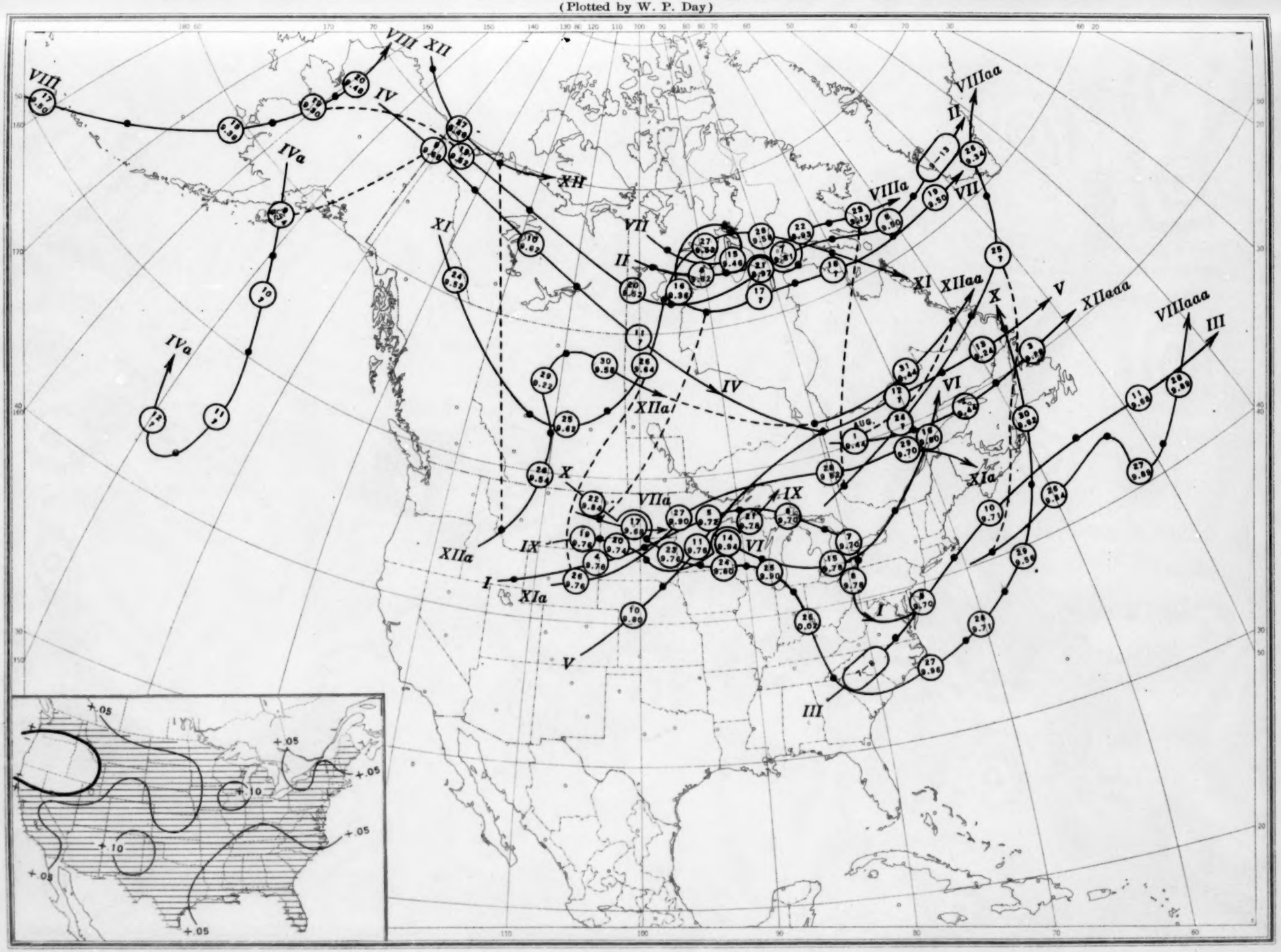
Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, July 1935. (Inset) **Change in Mean Pressure from Preceding Month**

Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, July 1935. (Inset) Change in Mean Pressure from Preceding Month

(Plotted by W. P. Day)



Circle indicates position of cyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 8 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, July 1935

Chart V. Total Precipitation, Inches, July 1935. (Inset) Departure of Precipitation from Normal

Chart V. Total Precipitation, Inches, July 1935. (Inset) Departure of Precipitation from Normal

Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, July 1935

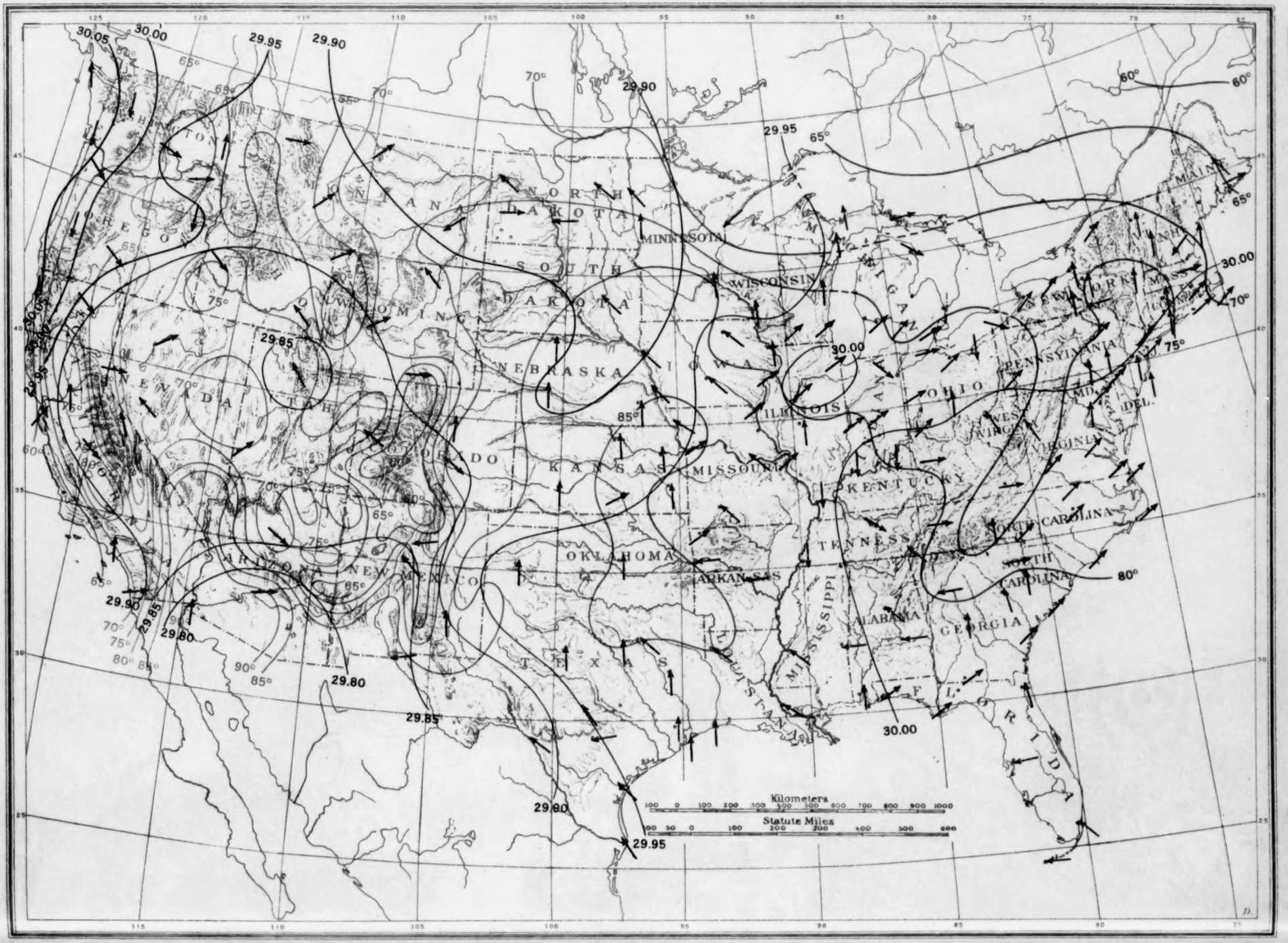


Chart VII. Wind Roses for Selected Stations, July 1935

Chart VII. Wind Roses for Selected Stations, July 1935

(Plotted by E. Corbin)

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